EVIDENCE REPORT AND EVIDENCE-BASED RECOMMENDATIONS:

HEALTH RISK APPRAISALS AND MEDICARE

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INTRODUCTION

The evidence linking lifestyle to health and function is indisputable and continues to grow. The need for systematic and comprehensive approaches to health that identify and address not just essential clinical services, but also lifestyle changes, is important. One promising approach that targets both needed clinical services and lifestyle behaviors is the health risk appraisal. Health Risk Appraisal (HRA) is a systematic approach to collecting information from individuals that identifies risk factors, provides individualized feedback, and links the person with at least one intervention to promote health, sustain function, and/ or prevent disease. A typical HRA instrument obtains information on demographic characteristics (e.g., sex, age), lifestyle (e.g., smoking, exercise, alcohol consumption, diet), personal medical history, and family medical history. In some cases, physiological data (e.g., height, weight, blood pressure, cholesterol levels) are also obtained. The Health Care Financing Administration (HCFA) commissioned this report to evaluate the potential effectiveness of HRA and programs using HRA as a health promotion tool, and to provide evidence-based recommendations regarding the use of HRA in health promotion programs for older adults. Specifically, HCFA asked RAND to address the following questions:

1. How good is the evidence that HRA interventions have beneficial effects? Do they have a positive impact on quality of life, health status, health outcomes, and satisfaction?
2. What is the value of different levels of intensity in follow-up (e.g., a self-management book vs. self-management book and nurse follow-up phone calls or community referrals)?
3. What are the key features of HRA surveys and follow-up interventions?

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7. What is the role of technology in HRA administration?
8. How have issues of confidentiality and privacy been addressed?
9. Does the integration of social, public health, and medical approaches enhance healthy aging? Does the opportunity to integrate these three approaches exist through HRAs?

The final question was determined to be beyond the scope of this evidence-based report. However, a report from the Institute of Medicine[1] recommends a social environmental approach to health and health interventions, which is worth mentioning as it relates to this question.

METHODS

In order to answer the questions, an extensive literature review was undertaken using the following steps:

- identify sources of evidence (in this case, sources of scientific literature)
- identify potential evidence
- evaluate potential evidence for methodological quality and relevance
- extract study-level variables and results from studies that meet methodological and clinical criteria
- synthesize the results.

RAND staff searched Medline, PsycINFO, PsychLit, Embase, Social Science Abstracts, and Current Contents for literature on HRAs. We also searched the Internet using the search engine Metacrawler. Upon receiving articles, RAND staff reviewed each reference list for additional relevant articles. The reference lists of the review articles demonstrated that the

largest single source of published material about HRAs was the Annual Proceedings of the Society for Prospective Medicine (SPM). The Society sent RAND all locatable proceedings from prior conferences that had been referenced in the review articles. We also ordered entire proceedings from the two most recent conferences (1998 and 1999) as well as the newly published “SPM Handbook of Health Assessment Tools." Finally, RAND staff presented a preliminary draft report to an expert panel, and several members sent additional articles that the initial search had not identified.

Two researchers independently reviewed each article to determine whether to include it in the evidence synthesis. To be included, the HRA intervention had to a) deliver feedback to the client, b) be based on client self-report, and c) cover multiple domains. The term “domains” refers to health conditions or risks, such as prevention of cardiovascular disease or use of seat belts to prevent injury due to accidents. Furthermore, the feedback had to consist of specific recommendations for action. Finally, in order to be included in our analysis of the evidence on behavioral, health screening, physiological, and psychological outcomes, the study had to include a control group. Uncontrolled studies and descriptive pieces are included in the response to the question about technology due to lack of controlled studies in this area. Although we were primarily searching for data relevant to the Medicare population, studies of populations under age 65 were included to avoid premature loss of potentially useful data.

The evidence was too sparse and/or too heterogeneous to support statistical pooling. Thus, this summary of the evidence is qualitative rather than quantitative.

RESULTS

Based on the literature search and expert panel feedback, a total of 267 journal articles, unpublished reports, and conference presentations were requested. Of the 256 documents that could be obtained, 95 did not report studies of actual health risk appraisals (i.e., they studied comprehensive geriatric assessments, the P_{RA} [Probability of Repeat Admission] instrument, and assorted health education materials). Forty-four other publications reported on tools that were defined by the authors as HRA but did not meet screening criteria (i.e., not based on self-report, no feedback given to patient, or restricted to a single domain). Another 37 articles were reviews, background information, or simple descriptions of an HRA. This left 80 publications that reported on research studies.

Twenty-nine of the 80 publications reported on controlled trials. A few articles reported on the same study, thus 27 studies were represented. These studies are included in the review of the evidence for effectiveness. Thirteen studies were randomized controlled trials (RCTs), four were controlled clinical trials (CCTs) and ten were controlled before and after studies (CBAs). The remaining articles reported on uncontrolled studies (cohort, simple pre/post) or studies that did not report health or behavioral outcomes (i.e. reports of validity, reliability, or ease of administration).

The quality of the included studies is mixed. Only half the controlled studies reported the percentage of eligible, contacted individuals who agreed to participate in the study. These percentages ranged from 15% to over 70%. All studies reported retention rates at follow-up; 17 of the 27 articles reported at least 70% retention for all groups. Length of follow-up ranged from 1 to 48 months.

Responses to the questions posed by HCFA are summarized below.

QUESTION 1. *How good is the evidence that health risk appraisals have beneficial effects? Do HRA interventions have a positive impact on quality of life, health status, health outcomes, and satisfaction?*

The effects of HRA interventions on the following types of outcomes were investigated: behavioral, use of cancer screenings, physiological, health status, and psychological. Together, results from these studies provide evidence for the potential benefit of HRA interventions on behavior (particularly exercise), physiological variables (particularly blood pressure and weight), and general health status. Results vary across studies. The reasons for differing results are not known, but may include that different measures were used to assess similar outcomes, and studies used varying levels of follow-up, making direct comparisons difficult. Less evidence was found for beneficial effects of HRA on screening utilization and psychological outcomes than for other desired changes.

The most consistent evidence for HRA effectiveness on behavioral variables comes from studies of exercise habits. Eleven studies reported a beneficial effect on exercise habits, one reported a negative effect, and five reported no significant group differences. However, the use of different exercise measures across studies makes direct comparisons difficult and, in some studies, the clinical importance of the observed increase in exercise is questionable. Less consistent results were found for other commonly studied behaviors, with significant beneficial effects found for 6 of 15 smoking behavior studies, 2 of 9 alcohol use studies, and 1 of 4 diet studies.

Physiological parameters investigated in more than one study include body-mass index (BMI), weight, or percent body fat; blood pressure; and cholesterol level. Beneficial effects were found in seven of the 14 blood pressure studies, with more of an effect found for diastolic blood pressure than in systolic blood pressure. Further, seven of the 16 controlled studies that investigated BMI, weight, or body fat found a beneficial effect of HRA interventions. Of the small number of studies focusing on cholesterol, beneficial effects of HRA interventions were found in two (of seven) studies. Assessments of health status used in more than one of the eleven relevant controlled studies include HRA risk age, general health status, number of sick or disability days, risk of heart disease, risk of cancer, and mortality risk. All three studies that included a measure of general health status found a beneficial effect, as did three of the five studies focusing on HRA risk age.

Only six studies investigated whether HRA prompted individuals to obtain health screenings (e.g., breast exam, pap smear, rectal exam, etc) and seven studies focused on psychological distress (e.g., anger, anxiety, depression, and stress). These small groups of studies do not contain sufficient evidence to draw firm conclusions about the effectiveness of HRA interventions on health screening outcomes or psychological distress.

QUESTION 2 AND 3. *What is the value of different levels of intensity in follow-up? What are the key features of HRA surveys and follow-up interventions?*

To further evaluate the effectiveness of programs using HRA, we classified the studies in terms of the intensity of the intervention. The least intensive interventions involved providing HRA feedback to participants (sometimes combined with providing standard educational materials). More extensive interventions involved providing HRA feedback with some type of

supplemental counseling from a physician, health educator, or other individual. The most extensive interventions provided HRA feedback plus the opportunity to participate in a health promotion program. Within these broad categories, considerable variation exists across studies in the extent of involvement in the intervention, availability of materials and programs to participants, and length of follow-up. However, the data suggest that more intensive interventions yield better results.

Feedback Only. Ten controlled studies included a group that received HRA with feedback only. These studies found very limited benefit from HRA feedback alone on the parameters under investigation.

Feedback plus counseling. Eleven controlled studies investigated the effects of receiving HRA feedback plus counseling. The feedback and counseling was provided by a physician in five studies and by a nurse in two studies. Other studies referred to the person who provided the feedback as a “health educator" or did not specify the background of the person. Several of these studies found no effect or effects on a very limited number of the health parameters under investigation. One study found that participants who received counseling and those who received counseling plus monetary incentives for behavior change had higher smoking cessation rates and smaller increases in BMI than did two groups who did not receive counseling. However, no differences were observed between the “counseling” and “no counseling” groups with respect to changes in percent body fat, blood pressure, cholesterol, or aerobic capacity (a measure of fitness). Further, it is not clear from these results whether counseling alone without additional monetary incentives has beneficial effects on these health parameters.

Feedback plus health promotion programs. Fourteen controlled studies combined HRA feedback with the opportunity to engage in a health promotion program. Many of these programs showed initial promise, although evidence for their long-term effectiveness is less strong. All five studies that used the most robust design (RCT) showed significant benefits of combining HRA with participation in a health promotion program. In addition, all five focused on older adults. Participants in four of the studies were Medicare beneficiaries, while the fifth study involved Bank of America retirees. Results are briefly described below.

In the 1980s, HCFA funded a congressionally mandated demonstration project that included preventive services for Medicare beneficiaries. In each of five geographic areas patients completed an HRA, although use of the information differed widely. The projects were evaluated by both the study team and Abt Associates.[2] At one site, Mayer and colleagues found significantly greater improvements among individuals who completed an HRA and were offered an 8-week health promotion workshop compared to those who completed an HRA and received only usual care, on a number of health-related parameters at 12-month follow-up.[3] By the 24- and 48-month follow-ups, the beneficial effects of the intervention remained for metabolic rate and engagement in stretching exercises and metabolic rate.[4]

At another location, Patrick and colleagues compared "usual care" to a package of preventive services that included HRA, a health-promotion visit, a disease-prevention visit, and follow-up classes.[5] At the 24-month follow-up, this study found that the intervention group showed significantly greater improvement than did the control group on the following health-related parameters: physical activity (27% vs. 21% improved, respectively), obtaining flu shots (17% vs. 12% improved, respectively), quality of life, global health status, depression, and health worry. At the 48-month follow-up, the effects for flu shots, depression, and health worry

remained. Group differences were not found for other health-related behaviors, including smoking, alcohol, diet, seat belt use, home safety, medication awareness, breast self-exam, BMI, total health care costs, and stress.

At another HCFA demonstration site, Williams and colleagues utilized HRA feedback by a health educator, educational materials, an 8-week workshop, booster telephone calls, and a newsletter.[6] After four years, the intervention group showed greater improvements in metabolic rate, self-reported stretching activity (from 15 to 20 minutes per week), depression, and immunization rate compared to a group who completed an HRA only (differences were not found on diet, BMI, or blood pressure).

Leigh and colleagues reported on the effects of the 12-month Healthtrac intervention among a group of Bank of America retirees.[7] Of the interventions we reviewed, Healthtrac is the only one delivered exclusively through the mail. Participants in this study completed an HRA and received feedback every 6 months. The feedback consisted of a personalized risk report and recommendation letters (based on the HRA), newsletters, books, and other materials. Compared to a control group who completed an HRA but did not receive feedback, intervention participants reported greater improvement on several self-reported dietary habits (servings of fat, salt, whole-grain breads and cereals, fiber, eggs, and cheese), but not on others (servings of fruits, vegetables, calcium-rich foods, red meat, and butter). Intervention participants reported greater improvement on all health status variables (such as health risk score, global health status, sick days, and disability/illness) except arthritis. Further, intervention participants reported greater improvement on several psychological variables (feeling rushed, angry and stressed), although group differences were not found on tenseness or tranquilizer use. With the exception of seat

belt use, behavioral variables (smoking, alcohol use, or exercise) and physiological variables (weight, diastolic or diastolic blood pressure, or cholesterol) showed no group differences.

QUESTION 4. *Do HRA interventions reduce health care costs by reducing disease and utilization of services?*

Few studies of HRA analyzed their cost-effectiveness. However, we reviewed both the HCFA-funded demonstration programs and the Healthtrac program (both discussed in Questions 2 & 3) as well as the cost-effectiveness results for worksite-based programs. These programs were difficult to compare in terms of cost due to heterogeneous research designs, implementation, and multi-component interventions. Also, the studies used various definitions and measurements of program costs and effectiveness. Keeping that in mind, results are presented below.

Cost-effectiveness of programs using HRA

Type of program	How HRA info used	Costs/ Participant	Effectiveness	Reference
COBRA: comprehensive coverage for disease prevention and health promotion services provided to elderly Medicare beneficiaries.	Data collected and analyzed but status of feedback and follow-up evaluation unknown.	$159 to $306 (2 years) (1994 values)	Changed some health behaviors that involved minimal effort; some short term health improvement demonstrated in some programs; HRAs applied with limited intervention intensity and of uncertain effectiveness for older adults; did not produce Medicare cost-savings as implemented in these demonstration programs	Burton, 1995a; Elder, 1995 ; German, 1995; Lave, 1996 ; Morrissey, 1995 ; Patrick, 1999; Schweitzer, 1994; Williams, 1997.
Healthtrac: Sequential HRA intervention participants received HRA reports, personalized recommendations, self-management and educational materials.	Data collected and analyzed by computer program. Participants received periodic graphic summary of HRA reports and recommendations.	Approximately $100 for higher risk participants (per year), $30 for all others.	Improvement in health risk scores; self-reported change in some health behaviors (such as smoking, diet, alcohol; exercise; cholesterol; and reported stress); reduction in self-reported medical utilization; reduction in medical costs.	Fries, 1992; Fries, 1993a; Fries, 1993b; Fries, 1998; Leigh, 1992.
Nine worksite-based and one home-based health promotion programs.	Implemented in a wide variety of manners. In some programs HRA was key intervention and in others HRA was neglected or used for non-health promotion purpose.	Cost varied widely: no consistent method used for imputing intervention costs.	Majority of the studies showed positive cost-effectiveness results and some demonstrated cost-beneficial or positive ROI estimates. However, no attempt to demonstrate the impact of programs or HRA on results.	Acquista, 1988; Bertera, 1990; Erfurt Holtyn, 1991; Gibbs, 1985; Golaszewski, 1992; Harvey, 1993; Hornsby, 1997; Ozminkowski, 1999; Reed, 1986; Sciacca, 1993.

COBRA = Consolidated Omnibus Budget Reconciliation Act
HRA = Health Risk Appraisal
ROI = Return on Investment

As stated earlier, in the late 1980s the Health Care Financing Administration (HCFA) funded demonstration programs to evaluate the cost and effectiveness of comprehensive coverage for disease prevention and health promotion services to elderly Medicare beneficiaries. The demonstration required all projects to conduct health risk appraisal interviews with participants. In addition, all projects randomized participants to a control group that received usual care and an intervention group that received newly waived disease prevention services (such as immunizations and health risk screenings) and health promotion/education services (such as nutrition and exercise workshops, and alcohol and smoking cessation counseling). Other than those two common program designs, the projects differ in almost every aspect. Differences included waivered service packages, the socio-demographic characteristics of the participants, methods of recruitment, types of geographic area covered (urban vs. rural), research design, and measurement issues. Each site used the information collected in the HRA in different ways. The average expenditure per intervention participant ranged from $159 in Pittsburgh to $306 in Washington.[2] As for the overall effects of the prevention demonstration, in some programs the evaluation found short term improvements in health behaviors and health status, but did not produce savings in Medicare expenditures.[2]

Many issues have been raised and explanations offered for the apparent lack of cost savings from the Medicare demonstration. These include the uncertain effectiveness of particular prevention interventions in older adults, insufficient length of follow-up period, limited intervention intensity, and non-representative sample of Medicare beneficiaries.[2, 4, 5, 8-10]

Studies of the Healthtrac program described earlier[7, 11-14] also examined cost-effectiveness. The standard intervention consisted of a sequential time-oriented HRA followed by a mailed health-promotion package every six months. The package included serial personal health risk reports and feedback of progress in behaviors/outcomes from prior time periods, personalized recommendation letters tailored to individual health risks, and self-management materials and other educational materials specific to identified risks. One Healthtrac study[14] implemented a more intensive intervention to higher risk individuals: a package similar to the standard one was delivered but in three-month instead of six-month cycles. The cost of the intervention averaged $30 per participant per year in all studies except the latter one, where the cost for the higher risk group was about $100 per year. Unlike the HCFA demonstration, where the interventions provided coverage for preventive services, no clinic visit or service costs were included in program costs. The study that targeted a higher-risk group with more intensive interventions found that preliminary return on investment (ROI) at a six-month follow-up was approximately 6:1 for the higher-risk group compared with 4:1 for the lower-risk group.

The lack of agreement between the results of the Healthtrac studies and those of the HCFA demonstration could be attributable to several possible factors. First, the sequential feedback of HRA information along with individualized recommendation letters and self-management and educational materials provided by Healthtrac may encourage health behavior modification. Second, on-going interventions help sustain program effects. Healthtrac sent sequential HRA interventions to its participants every six months through the end of the evaluation period. Other factors that could account for the differences include the study of different populations of enrollees and the use of differing measures of outcome and cost.

Extensive reviews of the outcomes of worksite-based health promotion programs, some of which included HRA, have supported the clinical effectiveness and cost-effectiveness of such programs. RAND's review of ten workplace studies showed favorable cost-effectiveness results for the evaluated programs. HRA was used in various ways in the programs, ranging from its use as an analytic tool for projection purposes,[15] with no indication of its implementation or impact,[16] to its use as a core intervention for health management purposes.[17] These worksite-based studies generally did not use a randomized controlled design and occasionally did not include any control group, which calls into question the internal validity of the studies. In addition, the worksite-based programs were offered only to employees but not to retirees.

QUESTION 5. *Does the evidence suggest that HRAs should be delivered to the whole population or to selected subsets, such as high-risk individuals?*

With the exception of studies involving older adults, the interventions provided limited evidence on which to evaluate the effectiveness of HRAs in vulnerable populations. No study specifically investigated the effectiveness of HRA across racial/ethnic groups and only two uncontrolled studies included a predominantly minority sample.

QUESTION 6. *What are special variations of HRAs for the older adult population?*

Existing HRAs for seniors are described briefly and summarized in the table below. Most have not been tested for effectiveness.

Senior Healthtrac. Developed by James Fries, Stanford University. This program, based on self-efficacy theory, consists of completing health risk questionnaires at six-month intervals. Computer-based serial personal health risk reports are provided every six months, along with

individualized recommendation letters, newsletters, self-management and health promotion books, and other program materials. The instrument contains 14 modules on various health risks and major chronic diseases. Controlled trials are described in the body of this report.

HRA – Older Adults. Available from the Healthier People Network, Decatur, GA. This organization continues work begun by the CDC and supported by the Carter Center in the late 1980s. Questions are divided into eight modules on various health risks. Where possible, quantitative estimates of risk are calculated. The questionnaire can be completed in less than one hour.

HRA – Elderly. Developed by John Beck, Lester Breslow, and colleagues at UCLA. Items in the questionnaire cover a comprehensive range of content domains relevant to health promotion in the elderly. Reports are generated for participants and their physicians. The instrument was tested recently in senior centers, in a medical practice, and in random community samples.

Interactive Multimedia HRA. Produced by the Oregon Center for Applied Science, Eugene, OR. This tool employs a kiosk system intended for use in medical facilities and senior centers. Based on touch-screen responses, the system creates a report designed to encourage specific behavior change in older adults.

Personal Wellness Profile – Senior Edition. Available from Wellsource, Inc. Clackamas, OR. Targeted primarily towards healthy individuals, this instrument is used by some Medicare HMOs for risk data collection. When used for this purpose, it is usually administered via mail. The 39-item questionnaire can be completed in about 15 to 20 minutes, not including collection of optional clinical test data.

Senior Health Profiles. Available from Geriatric Health Systems, LLC, San Francisco, CA. This tool is used by some Medicare health plans for risk stratification. Risk probabilities are calculated using the nation's largest Medicare risk factor and probability database. Data are collected by mail or telephone.

Summex Senior Health Monitor. Available from Summex Corporation, Indianapolis, IN. Designed for Medicare managed care programs this instrument covers over 40 health dimensions. The length of time to complete the instrument is estimated to be only 8 to 10 minutes.

YOU FIRST Senior Health Assessment. Available from Greenstone Healthcare Solutions, Kalamazoo, MI. Detailed, targeted reports aid in increasing the speed with which the primary care provider identifies and acts on clients requiring care and targeting interventions. Includes a 15-item "readiness to change" scale.

Administrative Characteristics of HRAs for Older Adults

Title	Spanish Available	Other Languages	Scannable Forms	Screen-based	Number of items	Reading level (grade)	Length of report (pgs)
Senior Healthtrac	X	X	X	X	32-200	6	2-4
HRA – OA	X	X	X	X	152	5	7
HRA – E	X	X	under development		100+	8	8-12
Interactive HRA				X	80	10	2-5
Personal Wellness Profile - Senior	X		X	X	39	6.3	8
Senior Health Profile	X				31	8	2
Summex Senior Health Monitor	X	X	X		61	6	5
YOU FIRST Senior Health Assessment					32	8	?

QUESTION 7. *What is the role of technology in HRA administration?*

The widespread use of personal computers in the 1980s and the Internet in the 1990s has led to new and innovative ways of administering health information programs. Through computer technology, health information and behavior change strategies can be customized on the basis of a person's unique needs. Recent studies have found that these individually tailored materials are more effective than those designed for broad audiences. Computer technology will allow increasing sophistication in HRA's ability to specifically tailor feedback and educational materials to individuals.

Several promising interactive approaches have been developed in recent years, primarily by commercial firms. Although RAND found no controlled trials of these approaches, literature exists on development, implementation, and feasibility issues.

With many traditional HRA programs, feedback is delayed due to postal and processing time. However, an interactive computer kiosk or personal computer can deliver immediate feedback. For example, a Massachusetts firm has recently created an interactive voice HRA for use in a managed care setting.[18] The package allows for focused and tailored questioning and real-time dynamic feedback via the telephone. A Boston-area HMO recently collaborated with a large international employer to create a corporate health promotion plan[19] that included an interactive web-based HRA system. The project focused on education, self-care, and individual empowerment. On-site fitness centers and exercise reimbursements were also included. The computer system measured stages of change, used clinical algorithms to assess risk probabilities, and provided personalized feedback to the employee. To maintain confidentiality, the system

allowed participation anonymously or by case number identification. Results regarding changes in behavior and health status have not yet been published.

QUESTION 8. *How have issues of confidentiality and privacy been addressed?*

Little has been written about confidentiality issues regarding HRA and related programs. Most HRAs discussed in this report were used in the context of research studies that would require in most or all cases informed consent on the part of the participant and a data safeguarding plan. We recommend that any institution administering HRAs limit the number of people who have access to the data, ensure that those who do are aware of and accept their confidentiality obligation, and train them on procedures designed to prevent accidental disclosure during data collection, storage, analysis, and follow-up.

QUESTION 9. *Does the integration of social, public health, and medical approaches enhance healthy aging? Does the opportunity to integrate these three approaches exist through HRAs?*

This question was dealt with in a recent IOM report entitled *Promoting Health: Intervention Strategies from Social and Behavioral Research*.[1] The thrust of this report was that substantial improvements in prevention and management of chronic conditions were unlikely to be achieved without dealing with the social context in which patients live. Integrating social, public health, and medical approaches is necessary in order to achieve this. HRAs coupled with health promotion programs have the opportunity to be an important part of such integration, by identifying threats to health, providing recommendations tailored to an individual's specific medical and cultural context, and linking this with information on resources available within the community, such as senior centers.

CONCLUSIONS AND RECOMMENDATIONS

The number of controlled studies evaluating the effectiveness of Health Risk Appraisal (HRA) is limited and the quality of this evidence varies widely across studies. Keeping these limitations in mind, conclusions and recommendations based on the evidence were formulated by RAND and its panel of experts.

1. Effective HRA programs have demonstrated beneficial effects on behavior (particularly exercise), physiological variables (particularly diastolic blood pressure and weight), and general health status. More research would be useful to understand the effectiveness of HRA on other health parameters, such as clinical screening and psychological distress.

2. Interventions that combine HRA feedback with the provision of health promotion programs are the interventions most likely to show beneficial effects. Such studies have reported short to medium term effects on a variety of health behavior and physiologic outcomes. It is not known if these effects persist over the long term.

3. HRA questionnaires must be coupled with follow-up interventions (e.g., information, support and referrals) to be effective. The HRA questionnaire alone or with one-time feedback is not an effective health promotion strategy.

4. Evidence from which to draw conclusions regarding the effectiveness of HRA for older adults is limited, yet encouraging. Several randomized controlled trials of programs that included HRA found initial beneficial effects on some health parameters.

5. Current literature is insufficient to accurately estimate the cost effectiveness of programs using HRA. Limited evidence suggests that a carefully designed program that uses a systematic approach to implement HRA and subsequent disease prevention/health promotion interventions has the potential to be cost-beneficial. Considerable effort is needed to optimize program design, implementation, and evaluation.

6. All controlled research studies for which outcome data were collected used paper-and-pencil administration of the HRA, sometimes with telephone follow-up. Therefore, the potential impact of new modes of administration (personal computer, Internet) on the effectiveness and cost-effectiveness of programs that included HRA cannot be evaluated at this time.

7. No studies evaluated the effectiveness of HRA on specific racial and ethnic populations. Several senior HRAs are available in Spanish. Asian-language HRAs in the United States could not be located.

Given these conclusions, the following recommendations are made:

1. As HRAs have the potential to improve the health of seniors in a cost-effective manner, a Medicare demonstration to assess the effectiveness and cost-effectiveness of the HRA approach in comprehensively and systematically improving or maintaining health should be conducted.

2. A demonstration project should use regular, ongoing follow-up rather than one-time feedback or counseling, as this approach appears to be more effective. The level of intensity required in follow-up interventions is a question the demonstration will need to answer.

3. A demonstration project should explore the feasibility of linking beneficiaries to community-based services.

4. A demonstration project should compare different modes of HRA administration and follow-up (e.g., Internet, phone, mail) to learn more about their impact on costs and outcomes.

5. A demonstration project should explore how to translate the HRA approach into a benefit that might be incorporated within the Medicare program.

INTRODUCTION

The population of individuals over 65 years of age in the United States increased 11-fold from 1900 to 1994. In contrast, the population of individuals under age 65[20] increased in number only 3-fold. It is estimated that the number of individuals aged 65 or older will more than double during the period 1994-2050, from 33.2 million to 80 million.[20] Most older adults have at least one chronic illness; arthritis, hypertension, and heart disease are among the most prevalent.[21] Results from the 1995 National Health Interview Survey indicate that 37% of non-institutionalized older adults experience some activity limitation due to chronic illness, with 11% unable to carry out a major activity of living.[22] Older adults (those 65 and over) in this survey also reported 50% more disability days due to acute and chronic conditions than did those age 45-64 years.

However, disease and disability are not an inevitable consequence of aging. Changes in behavior and lifestyle reduce risk factors that lead to many diseases, and these changes are beneficial even for persons of advanced age. As is the case for younger adults, individuals 65 years or older who pursue a healthy lifestyle have lower morbidity and mortality risk.[23, 24] For example, evidence from the National Health and Nutrition Examination Survey 1971-75 (NHANES I) and the 1982-84 follow-up indicates that both smoking and less recreational physical activity predicted shorter survival time for middle-aged men (45-54 years old) and older men (65-74).[25] For older men, drinking alcohol and low body mass index (BMI) were associated with shorter survival time. Among older women, both less recreational physical activity and low BMI were associated with shorter survival. These results are similar to those from the Alameda study[26] which found that being a non-smoker, having normal weight, and consuming moderate

amounts of alcohol were associated with higher levels of functioning at a 19-year follow-up of older adults.

The evidence linking lifestyle to health and functioning is indisputable and continues to grow. The need for systematic and comprehensive approaches to health that identify and address not just essential clinical services, but also lifestyle changes, is becoming even more important. The Institute of Medicine (IOM) recently reviewed and reported on promising social and behavioral strategies, shedding light on interventions that should be part of a comprehensive and systematic approach to health. In its report, *Promoting Health: Intervention Strategies from Social and Behavioral Research,*[1] the IOM made the following recommendations:

- "Interventions to promote the health of older adults should focus on the social, environmental, and behavioral conditions that minimize disability and promote continuing independence and productive activity. Interventions that enhance the social support and self-efficacy of older adults are particularly promising.
- Understanding psychosocial and biobehavioral mechanisms that influence health is critical to better understand and tailor intervention efforts.
- Efforts to develop the next generation of prevention interventions must focus on building relationships with communities.
- Payers of health care should experiment with reimbursement structures to support programs that promote health and prevent disease."

The Health Care Financing Administration (HCFA) is interested in identifying comprehensive and systematic approaches to health, which address both clinical preventive and screening services and behavioral risk factor reduction. These approaches may already use or could incorporate some of the strategies mentioned in the IOM report.[1] HCFA commissioned this report to evaluate the potential effectiveness of health risk appraisal (HRA) as a health promotion tool and to provide evidence-based recommendations regarding the use of HRA in health promotion programs for older adults.

WHAT IS HRA?

We define HRA as a systematic approach to collecting information from individuals that identifies risk factors, provides individualized feedback, and possibly offers interventions to promote health, sustain function, and prevent disease. The preventive orientation of HRA distinguishes it from other assessment tools that focus on an individual's current health or functional status. An important premise underlying the philosophy of HRA is that individuals have the ability to make responsible decisions regarding their lifestyles and are capable of implementing these decisions with the intention of trying to prevent morbidity or forestall mortality.[27] As such, the active involvement of the individual in the HRA process is viewed as an important contributor to its success. The HRA process typically involves four-stages: data collection, data analysis, feedback/ follow-up, and evaluation.

Data Collection. The first stage involves collecting data about an individual. These data tend to be predominantly or entirely based on the individual's self-report. HRAs vary widely in the type and scope of information that is collected. A typical HRA instrument obtains information on demographic characteristics (e.g., sex, age), lifestyle (e.g., smoking, exercise, alcohol consumption, diet), personal medical history, and family medical history. Physiological data (e.g., height, weight, blood pressure, cholesterol levels) are also routinely obtained. Some HRAs collect additional information in domains such as cognitive functioning, readiness to change, mental health and perceived stress, job and life satisfaction, and health-related quality of life. Although our definition of the HRA approach includes both completing the HRA questionnaire and participating in an intervention, it should be noted that the HRA questionnaire itself is sometimes used as a tool for: a) identifying individuals with particular health care needs;

b) monitoring health behavior and tracking behavioral changes; c) increasing individuals' awareness of their need to make lifestyle changes; and d) customizing health promotion efforts.

Data Analysis. The second stage in the HRA process involves analyzing the information collected. This analysis may involve estimating the risk of disease or death from various causes for persons sharing the individual's characteristics as well as estimating the reduction in risk that could be achieved if the individual successfully corrected all the modifiable negative lifestyle factors identified by the HRA. Epidemiological and vital statistics data are used as the basis for these calculations. When all categories of health risk are assessed, an overall "risk score" may be assigned. However, many HRAs have moved away from the calculation of risk scores and, for the purposes of feedback to the individual, focus more exclusively on the identification of specific health risks.

Feedback/Follow-up. The third stage in the HRA process involves providing feedback or follow-up interventions to the individual based on the data analysis. This feedback/follow-up involves two components: a) providing the individual with personalized feedback on his/her current health risks; and b) providing the individual with personalized recommendations and/or interventions to modify his/her lifestyle in order to reduce those health risks. Feedback/follow-up can range from mailing the individual a simple report outlining his or her risk profile and providing recommendations to reduce risks, to counseling the individual and providing referrals, to more extensive interventions such as exercise lessons or smoking cessation groups.[28] Feedback/follow-up can be provided one-time or on an ongoing basis over time. The provision of feedback is an essential component of HRA. An underlying assumption of HRA is that the feedback will influence the individual to modify negative health habits in a way that will have a beneficial effect on the individual's physical health and functioning.

Evaluation. The fourth stage involves evaluation to assess the individual's progress in changing the targeted health behaviors and changes to the treatment plan that might be enhance its success.

HISTORY OF HRA

The 1970 publication of Robbins and Hall's seminal book *How to Practice Prospective Medicine* marked the general introduction of Health Hazard Appraisal (now known as Health Risk Appraisal or Health Appraisal) to clinicians and researchers. However, the true beginning of HRA, which predated this publication by more than 20 years, occurred in the late 1940s with Dr. Lewis C. Robbins' work on prevention of cervical cancer and heart disease.[29] Robbins was interested in shifting standard medical practice from its primary focus on disease treatment to a more prospective orientation that would emphasize both treatment *and* prevention. Documenting information on a patient's health hazards would provide the physician with a useful framework for discussing prevention issues with patients and initiating prevention efforts. Over the next two decades, this basic idea progressed from a simple "health hazard chart" for physicians' use to developing a complete HRA that included a patient questionnaire, health risk computation, and feedback strategies.[29]

HRA has been widely used in a variety of settings such as community health promotion programs, universities, worksites, and health maintenance organizations.[30] The initial proliferation, during the 1970s, of HRA instruments and their use has been attributed to a number of factors in addition to the publication of *How to Practice Prospective Medicine*. These factors include results from the classic Alameda County Study[31] which demonstrated the positive health consequences of practicing good health habits, and advocacy for HRA by the Society of Prospective Medicine.[32] Continuing interest in HRA has likely been fueled by the perception of

HRA as being a sound scientifically-based instrument, its relatively low cost and ease of implementation, its ability to deal with the combined health effects of multiple risk factors, its capacity to organize and present health promotion information in an appealing framework, and its attraction to consumers who are interested in receiving personalized and specific recommendations for health behavior change and other prevention activities.[33]

USE OF HRA IN OLDER POPULATIONS

The shifting demographics of this country, combined with longer average life expectancy,[34] highlight the importance of focusing on health promotion efforts for older adults.[35] It is clear from recent literature that lifestyle habits have a significant effect on health and functioning.[23-25] Large cohort studies like MRFIT and the Chicago Health Association Project in Industry showed that nonsmokers with favorable levels of cholesterol and blood pressure (with no history of diabetes, myocardial infarction or ECG abnormalities) have far lower risk of coronary heart disease and greater longevity.[36] This was the case for both young men and middle-aged men and women. Similarly, the Nurses Health Study[37] found that middle-aged women who had a healthy diet, exercised for 1/2 hour per day, consumed alcohol moderately, were not overweight, and did not smoke had an incidence of coronary events that was more than 80% lower than the rest of the study population. Furthermore, "each of these factors independently and significantly predicted risk, even after further adjustment of age, family history, presence or absence of diagnosed hypertension or diagnosed high cholesterol level, and menopausal status."

HRAs originally designed for younger and middle-aged adults may have limited applicability to older adults for several reasons. For example, risk calculations based on younger and middle-aged adults may be inaccurate for older adults. Some HRAs emphasize reduction in

premature mortality rates and report outcomes in terms of 10-year mortality risk. HRAs designed for older adults should focus more on lifestyle risk or progression of illness and disability. Several HRA instruments designed for older populations are currently in use or under development.

In this report, we evaluate the effectiveness of HRA as a health promotion tool and provide evidence-based recommendations regarding its use in health promotion programs for older adults.

QUESTIONS PROVIDED BY HCFA

We were given the following questions by the Health Care Financing Administration (HCFA) to address in this evidence report.

1. How good is the evidence that HRA interventions have beneficial effects? Do they have a positive impact on quality of life, health status, health outcomes, and satisfaction?
2. What is the value of different levels of intensity in follow-up (e.g., a self-management book vs. self-management book and nurse follow-up phone calls or community referrals)?
3. What are the key features of HRA surveys and follow-up interventions?
4. Do HRA interventions reduce health care costs by reducing disease and utilization of services?
5. Does the evidence suggest that HRAs should be delivered to the whole population or to selected subsets, such as high-risk individuals?
6. What are special variations of HRAs for the older adult population?
7. What is the role of technology in HRA administration?
8. How have issues of confidentiality and privacy been addressed?
9. Does the integration of social, public health, and medical approaches enhance healthy aging? Does the opportunity to integrate these three approaches exist through HRAs?

The final question was determined to be beyond the scope of this evidence-based report. However, the Institute of Medicine recommends a social environmental approach to health and health interventions which is worth mentioning in this report. HRAs coupled with health promotion programs may offer the opportunity to help link medical and social interventions.

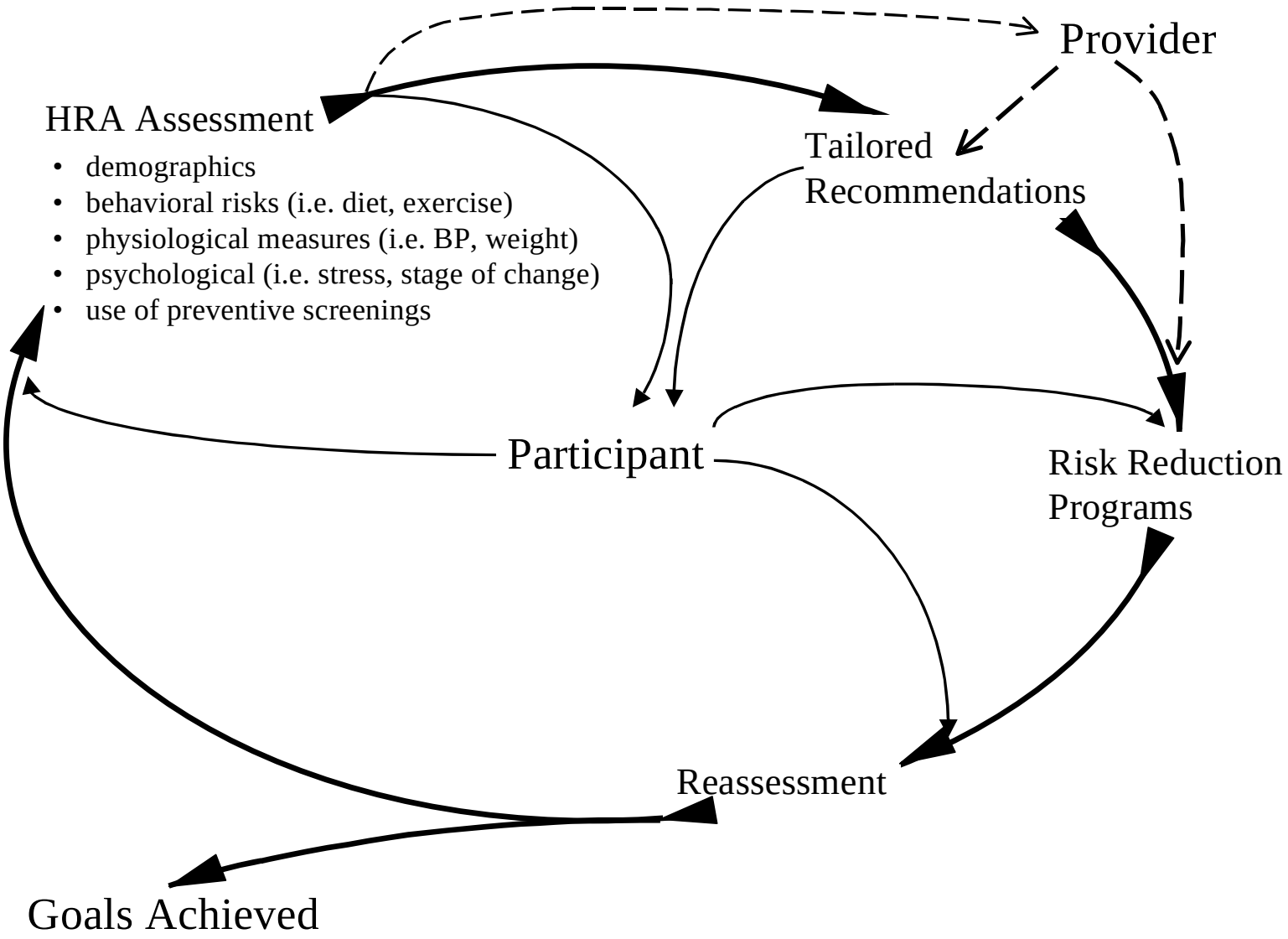
METHODS

In this report, we synthesize evidence from the scientific literature on the effectiveness of health risk appraisals and linked risk modification programs. We employed the evidence review and synthesis methods of the Southern California Evidence-Based Practice Center, an Agency for Healthcare Research and Quality (AHRQ)-designated center for the systematic review of literature on the evidence for benefits and harms of health care interventions. Our literature review process utilized the following steps:

- develop a conceptual model (also sometimes called an evidence model or a causal pathway)
- identify sources of evidence (in this case, sources of scientific literature)
- identify potential evidence
- evaluate potential evidence for methodologic quality and relevance
- extract study-level variables and results from studies meeting methodologic and clinical criteria
- synthesize the results.

Figure 1 displays the conceptual model. In our model, the participant completes an HRA without necessarily coming into contact with a medical provider. (For example, many of the HRAs studied have been administered in the workplace, at fairs, and in research settings.) The participant's own health care provider may or may not receive a copy of the participant's feedback report. This report should contain both recommendations and referrals or links to risk reduction programs where indicated. The participant should be periodically re-assessed by HRA in order to assess progress toward risk reduction.

Figure 1. Conceptual Model



LITERATURE SEARCH

We used the sources described below to identify existing research and potentially relevant evidence for this report.

Cochrane collaboration

The Cochrane collaboration is an international organization that aims to help people make well-informed decisions about health care by preparing, maintaining, and promoting the accessibility of systematic reviews of the effects of heath care interventions. The Cochrane Library contains both a database of systematic reviews and a controlled trials register. The library continually receives additional material to ensure that reviews are updated through identification and incorporation of new evidence. The Cochrane library is available on CD-ROM (and on-line) by subscription. We searched for studies containing the words "health risk appraisal" and "health risk assessment."

Library Search

Research staff searched Medline, Embase, Social Science Abstracts, Current Contents, and PsycINFO for entries that contained the terms "health risk appraisal" and "health risk assessment." The project manager reviewed the list of retrieved titles and ordered appropriate publications. In addition, all search terms used to catalog the Bank of America HRA study[11] were also run through the five aforementioned databases to find related articles.

Due to the limited number of HRA publications retrieved, we also searched the Internet using the search engine Metacrawler and the terms "health risk appraisal" and "health risk assessment." Metacrawler searches several engines at once, including Yahoo, Alta Vista, and Excite.

Health Services Research - 1987 Special Issue

In October 1987, the journal Health Services Research (HSR) published a special issue entitled "A Research Agenda for Personal Health Risk Assessment Methods in Health Hazard / Health Risk Appraisal." The issue consisted of a summary of a September 1986 conference sponsored by the Foundation for Health Services Research. The extensive bibliography included in this issue was added to the results of the literature search.

Previous Reviews

In addition to the HSR special issue, we identified 36 previously completed review and background pieces relevant to this project, and all relevant citations were retrieved. These articles are listed in the following table.

Table 1. Review and Background Articles

Anderson DR, Staufacker MJ. The impact of worksite-based health risk appraisal on health-related outcomes: A review of the literature. *Am J Health Promot.* 1996;10(6):499-508.

Becker MH, Janz NK. Behavioral science perspectives on health hazard/health risk appraisal. *Health Serv Res.* 1987;22(4):537-51.

Beery WL, Schoenbach VJ, Wagner EH, and colleagues. Description, analysis and assessment of health hazard/health risk appraisal programs: Final report. *National Technical Information Service.* 1981.

Bertera RL. Planning and implementing health promotion in the workplace: a case study of the Du Pont Company experience. *Health Educ Q.* 1990;17(3):307-27.

Black GC, Ashton AL Jr. Health risk appraisal in primary care. *Prim Care.* 1985;12(3):557-71.

Day HM, Roth LJ. The design and delivery of an HRA in the manufacturing setting. *Measuring Risk - Managing Outcomes: Using Assessment to Improve the Health Populations.* 1998:71-74.

DeFriese GH. Assessing the use of health risk appraisals. *Bus Health.* 1987;4(6):38-42.

Table 1: Review and Background Articles (continued)

Doerr BT, Hutchins EB. Health risk appraisal: process, problems, and prospects for nursing practice and research. *Nurs Res.* 1981;30(5):299-306.

Fielding JE. Appraising the health of health risk appraisal [editorial]. *Am J Public Health.* 1982;72(4):337-40.

Fletcher DJ, Smith GL. Health-risk appraisal. Helping patients predict and prevent health problems. *Postgrad Med.* 1986;80(8):69-71, 74-6, 81-2 passim.

Goetz AA, Duff JF, Bernstein JE. Health risk appraisal: the estimation of risk. *Public Health Rep.* 1980;95(2):119-26.

Goetz AA, McTyre RB. Health risk appraisal: some methodologic considerations. *Nurs Res.* 1981;30(5):307-13.

Goetzel RZ, Juday TR, Ozminkowski RJ. What's the ROI? A systematic review of Return-On-Investment studies of corporate health and productivity management initiatives. *AWHP's Worksite Health.* 1999:12-21.

Gran B. Population based CVD health risk appraisal. A method to create a "critical mass" of health-conscious people. *Scand J Soc Med.* 1994;22(4):256-63.

Heaney CA, Goetzel RZ. A review of health-related outcomes of multi-component worksite health promotion programs. *American Journal of Health Promotion.* 1997;11(4):290-308.

Hill L, Faine N. Using health risk appraisal in clinical practice. *West J Med.* 1992;156(5):535.

Hutchins EB. Health Risk Appraisal. AAPA's 27th Physician Assistant Conference: Atlanta, Georgia.

Hyner GC, Melby CL. Health risk appraisals: use and misuse. *Fam Community Health.* 1985;7(4):13-25.

Irvine AB. Interactive health risk appraisal for behavior change. *Health Education and Behavior.* 1997;24(1):8-9.

Jones RC, Bly JL, Richardson JE. A study of a work site health promotion program and absenteeism. *J Occup Med.* 1990;32(2):95-9.

Kirscht JP. Process and measurement issues in health risk appraisal [editorial]. *Am J Public Health.* 1989;79(12):1598-9.

Marciano LA. Rhode Island health risk appraisal program in worldwide use. *R I Med J.* 1985;68(5):227-8.

Table 1: Review and Background Articles (continued)

McDowell I. The validity of health risk appraisal [letter]. *Nurs Res.* 1982;31(6):347.

Meeker WC. A review of the validity and efficacy of the Health Risk Appraisal instrument. *J Manipulative Physiol Ther.* 1988;11(2):108-13.

Noell J, Glasgow RE. Interactive technology applications for behavioral counseling: Issues and opportunities for health care settings. *Am J Prev Med.* 1999;17(4):269-?

Pelletier KR. A review and analysis of the health and cost-effective outcome studies of comprehensive health promotion and disease prevention programs at the worksite: 1993-1995 update. *Am J Health Promot.* 1996;10(5):380-8.

Pelletier KR. Clinical and cost outcomes of multifactorial, cardiovascular risk management interventions in worksites: a comprehensive review and analysis. *J Occup Environ Med.* 1997;39(12):1154-69.

Robinson D, Allaway S. Health risk appraisal in the UK--some preliminary results. *Methods Inf Med.* 1998;37(2):143-6.

Saphire LS. Comprehensive health promotion: Opportunities for demonstrating value added to the business. *AAOHN J.* 1995;43(11):570-3.

Schoenbach VJ, Wagner EH, Beery WL. Health risk appraisal: review of evidence for effectiveness. *Health Serv Res.* 1987;22(4):553-80.

Schoenbach VJ, Wagner EH, Karon JM. The use of epidemiologic data for personal risk assessment in health hazard/health risk appraisal programs. *J Chronic Dis.* 1983;36(9):625-38.

Schoenbach VJ. Appraising health risk appraisal [editorial]. *Am J Public Health.* 1987;77(4):409-11.

Stretcher V, Kreuter M. The psychosocial behavioral impact of health risk appraisals. In Psychosocial Effects of Screening for Disease Prevention Detection, Oxford University Press, 1995.

Turner CJ. Health risk appraisals: the issues surrounding use in the workplace. *AAOHN J.* 1995;43(7):357-61.

Wagner EH, Beery WL, Schoenbach VJ, and colleagues. An assessment of health hazard/health risk appraisal. *Am J Public Health.* 1982;72(4):347-52.

Zimmerman E, Gold D. More than online health risk assessment. Integrating online HRA and resources into comprehensive health management programs. *Society of Prospective Medicine 35th Annual Meeting.* 1999:116-125.

Experts

As part of our background research several experts in the area of HRA were contacted. These experts were asked for any unpublished studies, articles under review, or recent conference presentations that might be relevant to the current report. After presenting a draft report to an expert panel, several members sent additional articles they felt were relevant to our study.

Society for Prospective Medicine

It was clear from the reference lists of the review articles that the largest single source of published material about HRAs was that compiled in the Annual Proceedings of the Society Prospective Medicine. The Society sent us all available proceedings from prior conferences that had been referenced in the review articles. However, some reports that dated back to the early 1970s could not be located. We also ordered entire proceedings from the two most recent conferences (1998 and 1999)[38, 39] as well as the newly published "SPM Handbook of Health Assessment Tools."[40]

Health Care Quality Improvement Projects (HCQIP)

Each U.S. state and territory is associated with a Medicare Peer Review Organization (PRO) that conducts various research projects. HCFA maintains a database with a narrative description of each research project, called the NPD (Narrative Project Document). An NPD includes the aims, background, quality indicators, collaborators, sampling methods, interventions, measurement, and results of a project. We searched the NPD database for any studies on HRAs. Since PROs have not been required to conduct interventions using HRAs, no projects were identified.

EVALUATION OF POTENTIAL EVIDENCE

After retrieving materials from the sources described above, a policy analyst and a behavioral scientist, each trained in the critical analysis of scientific literature, independently reviewed each study to determine whether or not to include it in the evidence synthesis. To conduct this review, we created a one-page screening form (Figure 2) with the exclusion criteria expressed as a series of yes/no questions. Based on the answers to these questions, an article was either accepted for further review or rejected. A third party (Dr. Shekelle) resolved any disagreements that remained unresolved after discussion between the two reviewers. Project staff entered data from the forms into an electronic database used to track all studies as they went through the screening process. Although we were primarily searching for data relevant to the Medicare population, we included studies of populations under age 65 to avoid premature loss of potentially useful data.

Figure 2. Article Screening Form

1. Article ID: _____

2. First Author: _____
(last name only)

3. Reviewer: _____

4. Subject of article:

	No	Yes
Health Risk Appraisals	0	1
Comprehensive Geriatric Assessments	0	1
Other	0	1

(IF OTHER, REJECT – STOP)

5. Does the HRA satisfy the following criteria?

	No	Yes
Is the instrument multidimensional (multiple domains)	0	1
Is the instrument based on self-report from client	0	1
Is feedback delivered directly to client	0	1
Does feedback consist of specific recommendations	0	1

6. Age range of subjects:_____ Low _____ to High
(if no lower boundary, enter "0"; if no upper boundary, enter "999")

7. How is instrument administered?

	No	Yes
Self-administered – paper	0	1
Self-administered – computer kiosk	0	1
Self-administered – Internet	0	1
Telephone	0	1
Other (specify: _____)	0	1

8. Study design (type of article/study design):

	No	Yes
Background (historical, opinion piece)	0	1
Research study testing hypothesis:		
RCT	0	1
CCT	0	1
CBA	0	1
ITS	0	1
Other research (specify: _____)	0	1
Descriptive research:		
Instrument development (reliability, validity testing)	0	1
Cohort study	0	1
Simple pre-post	0	1
Other descriptive (specify: _____)	0	1
Other (specify: _____)	0	1

9. Are costs of implementation / administration discussed?

	No	Yes
	0	1

10. Are behavioral outcomes measured? 0 1

11. Are health status outcomes measured? 0 1

12. Notes:

In order to be accepted as evidence, a study had to use one of the following study designs: randomized controlled trial, controlled clinical trial, controlled before and after study, or interrupted time series with adequate data points. Due to the small number of published studies on HRA, we also obtained observational studies that employed a simple cohort or pre/post intervention design for potential inclusion. We defined the study types according to the criteria described below.

Randomized controlled trial (RCT). A trial in which the participants (or other units) are definitely assigned prospectively into either "control" or "study" groups using a process of random allocation (e.g., random number generation, coin flips). "Study" groups receive a specific procedure, maneuver, or intervention.

Controlled clinical trial (CCT). A trial in which participants (or other units) are either:

a) definitely assigned prospectively to one (or more) "control" or "study" groups using a quasi-random allocation method (e.g., alternation, date of birth, patient identifier)

OR

b) possibly assigned prospectively to one (or more) "control" or "study" groups using a process of random or quasi-random allocation.

Controlled before and after study (CBA). A study in which the intervention and control groups become involved in the study other than by random process and in which the baseline period of assessment is included in the main outcomes. We used two minimum criteria for including CBAs in the review:

a) contemporaneous data collection – data on the pre- and post-intervention periods for the study and control sites are the same

b) appropriate choice of control sites – the study and control sites are comparable with respect to dominant reimbursement system, level of care, setting of care, and academic status.

Interrupted time series (ITS). An ITS study examines data trends and attributes a change in trend to an intervention. Such studies can be either retrospective or prospective. We used two minimum criteria for including ITS designs in our review:

a) a clearly defined point in time at which the intervention occurred

b) at least three data points before and three data points after the intervention.

Observational studies. These designs involve administering an intervention to a group and recording the outcome variable once before and once after the intervention. Such designs have no concurrent control group; therefore, they cannot account for temporal effects unrelated to the intervention.

STATISTICAL METHODS AND ANALYSIS

The evidence was too sparse and/or heterogeneous to support statistical pooling. As a result, our summary of the evidence is qualitative rather than quantitative.

For three outcome variables, blood pressure, smoking cessation, and serum cholesterol, there were sufficient studies that reported outcomes measured in identical units to justify summarizing their results in a forest plot of the study's reported outcome and 95% confidence interval. Heterogeneity among these studies in terms of the population enrolled, use of HRA in the intervention, and length of follow up was sufficiently great that we did not judge statistical pooling to be clinically justified.

For each intervention group in a study, and for the study's control group, we extracted the pre-intervention and post-intervention means and standard deviations or standard errors for those

means. We also extracted the sample size for each group. If the sample sizes reported before and after the intervention disagreed, we chose the post-intervention sample size. This sample size was always the smaller and, therefore, had a conservative effect on our calculations.

The effect size for each intervention group in a study to be plotted is the "difference of differences." This statistic equals the post-intervention mean in the intervention group minus the pre-intervention mean intervention group (the "intervention group difference") minus the analogously calculated control group difference. Intuitively, we take the difference between the outcomes recorded post-intervention between the two groups, having adjusted for any pre-intervention differences in the two groups by subtracting the pre-intervention mean in each group respectively.

In addition to calculating the effect size, we constructed a 95% confidence interval. The majority of the studies did not provide enough data to directly calculate the standard error of the effect size. Therefore we assumed the following underlying standard errors for each outcome: 16 mm HG for systolic blood pressure; 11 mm HG for diastolic blood pressure; and 50 mm/dl for cholesterol. These assumptions were based on a number of natural history articles that studied each of these outcomes. We also assumed no correlation between the pre-intervention and post-intervention means in any study group. This assumption of no correlation is conservative in the sense that the true correlation is probably positive, and assuming it to be zero will make the estimated confidence interval have greater coverage, i.e., the confidence level will be larger than 95%, resulting in a more conservative confidence interval.

For smoking cessation, we plot the quit smoking risk ratio and risk difference side by side. For several studies (see below) one of these statistics could not be estimated due to lack of

data or other problems. We used standard formulas to estimates these two statistics and their 95% confidence intervals. Extracting the appropriate data from some studies was challenging as we had to identify the number of smokers prior to the intervention in each group, and the number of smokers or quitters after the intervention.

For one study,[41] no smokers quit in the control group so the quit smoking risk ratio is not defined for any of the three treatment groups (left forest plot). For another study,[42] the right bound of the risk ratio confidence interval is 18.5 but we have bounded the plot at 10 (left forest plot). In a third study,[43] the risk ratio cannot be estimated from the available data as only the smoking prevalence post-intervention is reported and we thus could not determine the number of smokers prior the intervention (left forest plot).

EXPERT PANEL REVIEW

On April 7, 2000, we presented the draft evidence report to a panel of experts (Table 2) for feedback and discussion. At this meeting, we reviewed our methods and preliminary results and discussed potential models for demonstration projects. Many panel members suggested additional articles for review. These articles were sent to or ordered by RAND, and included in this final report. Extensive feedback from the expert panel was incorporated into the report and is reflected in the conclusions and recommendations.

Table 2. Expert Panel

Jessie Gruman, PhD, Chair
Center for Advancement of Health

Carson Beadle
President
The Health Project

John Beck, MD
Professor Emeritus
University of California, Los Angeles

Lester Breslow, MD, MPH
Professor Emeritus
Department of Health Services
University of California, Los Angeles

Larry S. Chapman, MPH
Summex Corporation

Jim Dewey, PhD
Executive Vice President
Quality Metric Inc.

James F. Fries, MD
Stanford University
School of Medicine

Axel Goetz, MD, PhD
Consultant

Ronald Goetzel, PhD
The MedStat Group

Bonnie Hillegass
Assistant Vice President
Sierra Health Services

Edwin B. Hutchins, PhD
President
Healthier People Network

Diane Justice
Deputy Assistant Secretary on Aging

Robert Lawrence, MD
Associate Dean for Professional Education and Programs
Johns Hopkins University, School of Public Health

Robin Mochenhaupt, PhD
Robert Wood Johnson Foundation

Disclaimer: Participation as an Expert Panelist does not indicate consensus with the recommendations of this evidence report.

RESULTS

DISTRIBUTION OF EVIDENCE

Based on our literature search and expert panel feedback, we attempted to obtain copies of 267 journal articles, unpublished studies, and conference presentations.

Figure 3 displays the sources of the retrieved literature. The Cochrane database contained no meta-analyses on the subject of HRAs and no randomized controlled trials. Likewise, as mentioned earlier, the search of the Medicare Health Care Quality Improvement Projects (HCQIP) found no reports. Our HCFA project officer provided 39 studies; many of these discussed a HCFA demonstration from the 1980s. Our own library search found 126 additional articles relevant to this undertaking. A search of the reference lists of these articles led us to order another 62 publications.

We also searched literature files accumulated through our work on other evidence reports for HCFA's Healthy Aging Project. The evidence report topics included ways to increase the utilization of Medicare-covered preventive and screening services (mammography, pap smear, colon cancer screening, influenza vaccine and pneumovax) and smoking cessation programs for seniors. In this way, we found 22 more studies that used some type of health risk assessment.

The most recent proceedings of the Society for Prospective Medicine (SPM) annual conferences[19, 39] included nine presentations that were deemed relevant to this report. These studies had not been referenced in any of our other HRA literature. Finally, after reviewing a draft version of this report, members of our expert panel sent 14 additional unpublished or previously unidentified reports directly to RAND.

We were able to obtain 256 of 267 requested publications. Of these, 95 did not study health risk appraisals (i.e. they studied comprehensive geriatric assessments, the P_{RA} (Probability of Repeat Admission), and health education materials). Forty-four other studies employed tools that were defined by the authors as health risk assessments but did not meet our criteria for this study (i.e., no feedback given to patient, results not based on self-report, or not multidimensional). Another 37 articles were reviews, background articles, or simply descriptions of an HRA, which left 80 reports of research studies.

Twenty-nine of the 80 publications reported on controlled trials. A few articles reported on the same study, thus 27 studies were represented. These studies are included in the review of the evidence for effectiveness. Thirteen studies were randomized controlled trials (RCTs), four were controlled clinical trials (CCTs) and ten were controlled before and after studies (CBAs). The remaining articles reported on uncontrolled studies (cohort, simple pre/post) or studies that did not report health or behavioral outcomes (i.e. reports of validity, reliability, or ease of administration).

Figure 3. Literature Retrieved - By Source

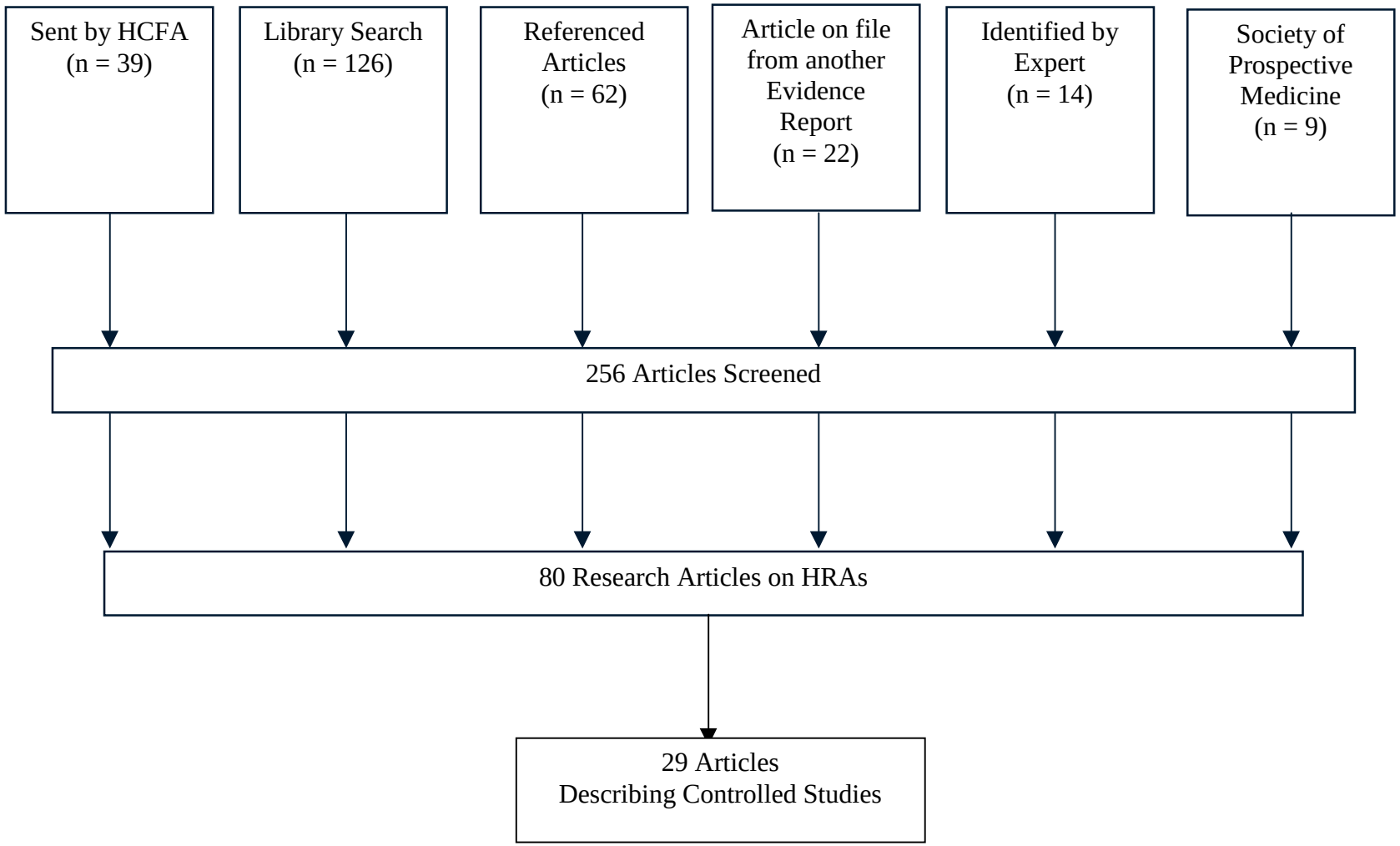


Table 3. List of Articles on Controlled Studies of HRA
Studies must contain health or behavioral outcomes

Article Authors, Year	Article Title Article Reference	Notes
Bertera, 1990	The effects of workplace health promotion on absenteeism and employment costs in a large industrial population Am J Public Health 1990 Sep;80(9):1101-5	
Blair, 1986	A public health intervention model for worksite health promotion: impact on exercise and physical fitness in a health promotion plan after 24 months JAMA 1986;255(7):921-6	Same as Shipley, 1988; Weinstein, 1986; Wilbur, 1984
Boudreau, 1995	Health risk appraisal in an occupational setting and its impact on exercise behavior. J Occup Environ Med 1995;37(9):1145-50	
Burton, 1995	The effect among older persons of a general preventive visit on three health behaviors: smoking, excessive alcohol drinking, and sedentary lifestyle Preventive Medicine 1995;24(5):492-497	Same as German, 1995
Clifford, 1991	Efficacy of a self-directed behavioral health change program: weight, body composition, cardiovascular fitness, blood pressure, health risk, and psychosocial mediating variables. J Behav Med 1991;14(3):303-23	
Connell, 1995	Effect of health risk appraisal on health outcomes in a university worksite health promotion trial Health Education Research: Theory and Practice 1995;10:199-209	
Dunton, 1990	The impact of worksite-based health risk appraisal programs on observed safety belt use Health Education Research: Theory and Practice 1990;5:207-216	
Elder, 1995	Longitudinal effects of preventive services on health behaviors among an elderly cohort. Am J Prev Med 1995;11(6):354-9	Same study as Mayer, 1994
Erfurt, 1991	Worksite wellness programs: Incremental comparison of screening and referral along, health education, follow-up counseling, and plant organization Am J Health Promot 1991;5(6):438-448	

Table 3. List of Articles on Controlled Studies of HRA (continued)
Studies must contain health or behavioral outcomes

Article Authors, Year	Article Title Article Reference	Notes
Family Heart Study Group, 1994	Randomised controlled trial evaluating cardiovascular screening and intervention in general practice: principal results of British family heart study BMJ. 1994;308:313-20	
Gemson, 1995	Efficacy of computerized health risk appraisal as part of a periodic health examination at the worksite. Am J Health Promot 1995;9(6):462-6	
German, 1995	Extended coverage for preventive services for the elderly: response and results in a demonstration population Am J Public Health 1995;85(3):379-386	Same study as Burton, 1995
Gomel, 1993	Work-site cardiovascular risk reduction: a randomized trial of health risk assessment, education, counseling, and incentives. Am J Public Health 1993;83(9):1231-8	
Johns, 1977	Health hazard appraisal--A useful tool in health education? Proceedings of the 12th Annual Meeting of the Society of Prospective Medicine, Bethesda, MD, 1977;61-65	
Kelly, 1988	Controlled trial of a time-efficient method of health promotion. Am J Prev Med 1988;4(4):200-7	
Kreuter, 1996	Do tailored behavior change messages enhance the effectiveness of health risk appraisal? Results from a randomized trial. Health Educ Res 1996;11(1):97-105	
Lauzon, 1977	A randomized controlled trial on the ability of health hazard appraisal to stimulate appropriate risk-reduction behavior. Doctoral Dissertation, University of Oregon, September 1977	
Leigh, 1992	Randomized controlled study of a retiree health promotion program. The Bank of American Study. Arch Intern Med 1992;152(6):1201-6	Same study as Fries, 1993
Logsdon, 1989	The feasibility of behavioral risk reduction in primary medical care. Am J Prev Med 1989;5(5):249-56	

Table 3. List of Articles on Controlled Studies of HRA (continued)
Studies must contain health or behavioral outcomes

Article Authors, Year	Article Title Article Reference	Notes
Mayer, 1994	Changes in health behaviors of older adults: the San Diego Medicare Preventive Health Project. Prev Med 1994;23(2):127-33	Same study as Elder, 1995
Nice, 1990	Self-selection in responding to a health risk appraisal: Are we preaching to the choir? Am J Health Promot 1990;4:367-372	
Patrick, 1999	Cost and outcomes of medicare reimbursement for HMO preventive services. Health Care Financing Review 1999;20(4):25-43	
Shi, 1992	The impact of increasing intensity of health promotion intervention on risk reduction. Eval Health Prof 1992;15(1):3-25	
Shipley, 1988	Effect of the Johnson Johnson Live for Life program on employee smoking. Prev Med 1988;17(1):25-34	Same study as Blair, 1986; Weinstein, 1986 and Wilber 1984
Smith, 1985	Use of Health Hazard Appraisal in counseling for reduction of risk factors. J Am Osteopath Assoc 1985;85(12):809-14	
Spilman, 1985	Effects of a corporate health promotion program. Journal of Occupational Medicine 1985;28(4):285-289	
Weinstein, 1986	Increasing automobile seat belt use: an intervention emphasizing risk susceptibility. J Appl Psychol 1986;71(2):285-290	Same study as Blair, 1986; Shipley, 1988 and Wilber 1984
Wilbur, 1984	Marketing health to employees. In: Frederiksen, LW, Et Al. (Eds.). Marketing Health Behavior. New York: Plenum. 1984	Same study as Blair, 1986; Shipley, 1988 and Weinstein, 1986
Williams, 1997	Preventive services in a Medicare managed care environment. Journal of Community Health 1997;22(6):417	

DESCRIPTIVE INFORMATION AND QUALITY OF EVIDENCE

The controlled studies that we reviewed are presented in detail in the Evidence Table (Appendix 1). It is important to note that in two cases, two of the RCT articles used the same sample of Medicare beneficiaries. In the first case, one article reported results from a 12-month follow-up[3] and the other reported results from a 48-month follow-up.[4] In the second case, the two articles reported results focusing on different sets of outcomes.[44, 45] Similarly, four of the CBA articles appear to use overlapping samples of employees who participated in Johnson Johnson's Live for Life program. Wilbur and Garner report on general results from the study at the 12-month follow-up,[46] whereas other articles focus on the specific behaviors of exercise,[47] smoking,[48] and seat belt use.[49] For the discussion below, these Live for Life reports are considered as separate studies. Thus 29 articles presented data on 27 studies. The "Notes" section of the Evidence Table indicates other overlapping articles that did not utilize control group designs.

Type of Study. Of the 27 controlled studies included in our analysis, 13 were randomized controlled trials, 4 were controlled clinical trials, and 10 were controlled before-after studies.

Types of Participants. Participants in the 27 controlled studies included the following: current or retired employees (n =16 studies), patients (n = 6), Medicare beneficiaries (n = 4), and YMCA members (n = 1). All studies used regional samples of presumably voluntary participants.

Recruitment and Retention. Lower recruitment rates limit the generalizability of study findings to wide-scale applications. Half the controlled studies reported on the percentage of eligible, contacted individuals who agreed to participate in the study. These percentages ranged

from 15%[50] to 40% to 69%[5, 51-54] to over 70%.[42-49, 55] One study reported relatively large differences in participation rates across conditions (26% to 77%).[56]

Lower retention rates limit the internal validity of studies, as the outcomes are not known for participants lost to follow-up. All studies reported information on retention rate at follow-up, with 17 of 27 controlled studies reporting retention rates of at least 70% for all groups. The studies with lowest retention rates tended to include older participants or had particularly long follow-ups.

Sample Size. The majority of controlled studies included at least several hundred participants per group, which would provide adequate statistical power to detect small-to-medium effect sizes using two-tailed tests (power = .80, alpha = .05). However, sample sizes varied considerably across studies. For example, the study by Clifford[57] included only 11 to 14 participants per group. Thus, results from this study should be interpreted in light of this limitation.

Length of Follow-Up. Length of follow-up in the 27 controlled studies varied from 1 to 48 months. Nine studies each reported on follow-ups of less than 10 months, follow-ups between 10 and 13 months, and follow-ups of 18 months or longer.

Outcomes and Measurement of Outcomes. The outcomes included in the 27 controlled studies could be categorized as follows: behavioral (e.g., physical exercise, smoking, alcohol consumption), use of health screening (e.g., breast exams, cholesterol testing), physiological (e.g., BMI, blood pressure), health status (e.g., global health status, sick days), and psychological (e.g., stress). Few studies investigated whether participation in HRA interventions lowered risk of disease or death; rather, proxy measures of health status such as blood pressure or cholesterol

were commonly used. Although physiological variables were often measured directly by members of the research team, studies largely relied on participants' self-reports of their health behaviors, use of health screenings, health status, and psychological well-being.

QUESTION 1. *How good is the evidence that health risk appraisals have beneficial effects? Do HRA interventions have a positive impact on quality of life, health status, health outcomes, and satisfaction?*

We investigated the effects of HRA interventions on the following types of outcomes: behavioral (e.g., physical exercise, smoking, alcohol consumption), use of health screening (e.g., breast exams, cholesterol testing), physiological (e.g., BMI, blood pressure), health status (e.g., global health status, sick days), and psychological (e.g., stress). Insufficient data on quality of life and satisfaction precluded an investigation of these outcomes.

Together, results from these studies provide evidence for the potential benefit of HRA feedback, or participating in a program with HRA feedback, on behavior (particularly exercise), physiological variables (particularly blood pressure), and general health status. Results vary across studies. The reasons for differing results are not known, but may include the use of different measures used to assess similar outcomes and varying levels of follow-up. The small number of studies focusing on screening utilization and psychological distress do not contain sufficient evidence to draw firm conclusions about the effectiveness of HRA interventions on these outcomes.

Behavioral outcomes

Twenty-six controlled studies investigated the effects of HRA interventions on various health behaviors. One of these studies[58] did not look at changes in specific health behaviors, but rather overall tendency to change any behavior. Another study did not specifically test for

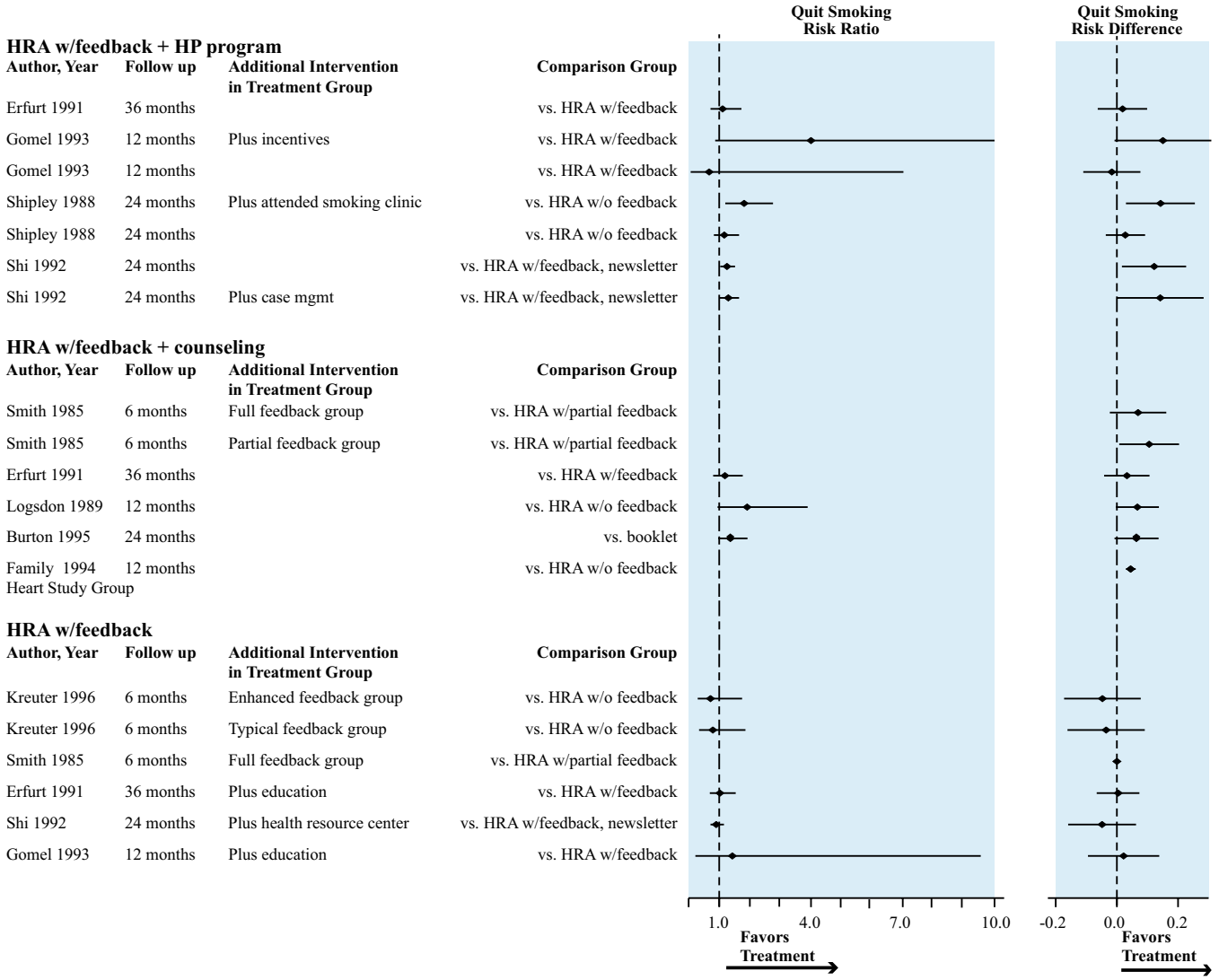
differences between the control and intervention groups.[54] Thus, we summarize results from the remaining 24 studies. With the exception of two studies of seat belt use[49, 59] and two studies of smoking cessation,[42, 43] results are based on self-reported behavior and are subject to all the usual concerns about the validity of such information. Behavioral changes assessed in more than one of the 24 studies include exercise (n = 18), seat belt use or other aspects of vehicle safety (n = 13), smoking (n = 15), alcohol consumption (n = 9), diet (n = 4), and home safety precautions (n = 3).

The most consistent evidence for HRA effectiveness on behavioral variables comes from studies of exercise. Eleven studies reported a beneficial effect on exercise, one reported a negative effect, and six reported no significant group differences. The use of different exercise measures across studies makes direct comparisons difficult, and preclude a visual summary using a forest plot. However, results from several studies provide some indication of the magnitude of the effects. Mayer and colleagues[3] found that intervention participants increased their weekly exercise over 12 months by an average of 4 minutes for stretching exercises and 7 minutes for strength exercises. (In comparison, the control group changed its weekly exercise by less than 1 minute, although the amount of time spent stretching increased slightly over the year.) The beneficial effect of the intervention persisted at the 48-month follow-up.[4] Similarly, Williams and colleagues[6] found that over 48 months intervention participants increased their stretching exercises by 5 minutes per week. Patrick and colleagues[5] reported that 27% of intervention participants improved their exercise habits compared with 21% of control group participants, while Logsdon and colleagues[53] found that 33.8% of sedentary intervention participants began an exercise program compared with 24.1% of control group participants.

Additional evidence of the effectiveness of HRA interventions can be seen in Figure 4, that presents the results of nine HRA studies that targeted smoking containing 19 comparisons and reported results in the proportion of people quitting smoking. Figure 4 plots the quit smoking risk ratio and risk difference side by side. By "side by side" we mean that for any study that contained data on more than one outcome of interest, e.g., in Figure 4 both a quit smoking risk ratio and a risk difference can be calculated for a study and these two statistics are plotted side by side. The side by side nature of the figures allows ease of comparison within an outcome domain. Underneath the horizontal axis on each plot we note the direction that "favors treatment." We also provide a vertical line at the relevant reference point (zero for risk difference effect sizes and one for risk ratios) that indicates where the intervention and control are equitable in terms of that outcome. The studies are grouped according to the intensity of the intervention used to implement the HRA results, with simple feedback at the bottom and health promotion programs at the top. The increased effectiveness of studies at the top of Figure 4 suggests that HRAs are more effective when coupled with health promotion programs than when simple feedback is used. Six additional studies of HRA that targeted smoking used other measures to report their outcomes and could not be included in Figure 4. Five of these studies reported no significant difference among groups.[5, 50, 52, 58, 60]

Less consistent results were found for the other commonly studied behaviors, with positive effects found for 4 of 13 vehicle safety studies (all assessing seat belt use), 2 of 9 alcohol use studies, and 1 of 4 diet studies. There were insufficient numbers of these studies that reported outcomes identically measured to justify creating a forest plot of outcomes.

Figure 4. Forest Plot of Smoking Cessation Studies



In Smith, 1985, no smokers quit in the control group so the quit smoking risk ratio is not defined for any of the three treatment groups (left forest plot). In Gomel, 1993, the right bound of the risk ratio confidence interval is 18.5 but we have bounded the plot at 9 (left forest plot). In Family Heart Study Group, 1994, the risk ratio cannot be estimated from the available data as only the smoking prevalence post-intervention is reported and we thus could not determine the number of smokers prior the intervention (left forest plot).

Health screening outcomes

Six studies investigated whether receiving HRA feedback, or participating in a program including HRA feedback, prompted individuals to obtain health screenings, and two studies investigated effects of HRA on immunizations. The screenings included breast self-exam (n = 5), rectal exam (n = 3), pap smear (n = 3), physician breast exam (n = 2), mammography (n = 2), and cholesterol test (n = 1). This small group of studies do not contain sufficient evidence to draw firm conclusions about the effectiveness of HRA interventions on health screening outcomes. Both studies investigating immunization rates found positive effects on utilization,[5, 6] as did 2 of 5 studies of breast self-examination rates.[53, 60] The only study of cholesterol testing found that individuals in the control group were less likely (40%) to be tested than were those in a group receiving enhanced HRA feedback (53%) but more likely than the group receiving typical HRA feedback (28%).[55] Thus, the limited evidence from these few studies suggests that HRA interventions may be effective in promoting clinical preventive and screening services, but more research is needed.

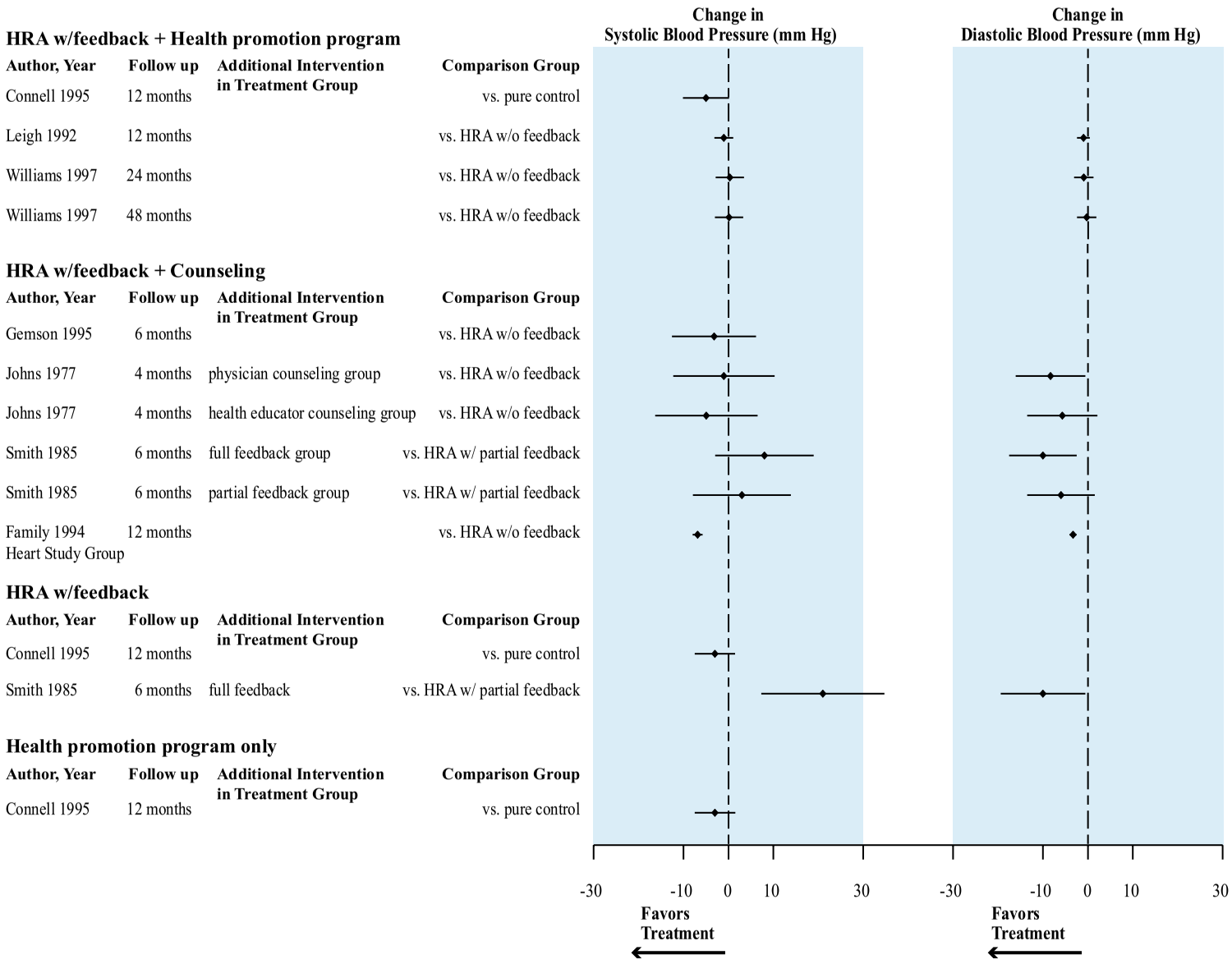
Physiological outcomes

Eighteen controlled studies investigated whether HRA interventions affected various physiological parameters. One of these studies is not considered in this section because it did not specifically test for differences between the control and intervention groups.[54] Physiological parameters investigated in more than one study include body-mass index (BMI), weight, or percent body fat (n = 16); blood pressure (n = 14); cholesterol level (n = 7); and metabolic rate (n = 2). Only four of these studies relied exclusively on self-report data.

Blood Pressure Studies. Fourteen studies reported on blood pressure. Seven studies containing 13 comparisons reported outcomes as change in millimeters of mercury (mmHg) and are summarized in Figure 5. This figure plots an effect size known as a "difference of differences" (defined in the methods section) for systolic and diastolic blood pressure side by side. By "side by side" we mean that for any study that contained data on both systolic and diastolic blood pressure results (not all studies reported on diastolic blood pressure), the two effect sizes for that study are plotted on the same horizontal line. The side by side nature of the figures allows ease of comparison within an outcome domain. Underneath the horizontal axis on each plot we note the direction that "favors treatment." We also provide a vertical line at the relevant reference point (zero for difference of differences) that indicates where the intervention and control are equitable in terms of that outcome. As in Figure 4, studies are grouped from bottom to top in order of increasing intensity of intervention for implementing the recommendations of the HRA. Figure 5 shows more of an effect of HRA programs on diastolic blood pressure than on systolic blood pressure, and no apparent trend in increasing effectiveness with increasing intensity of intervention.

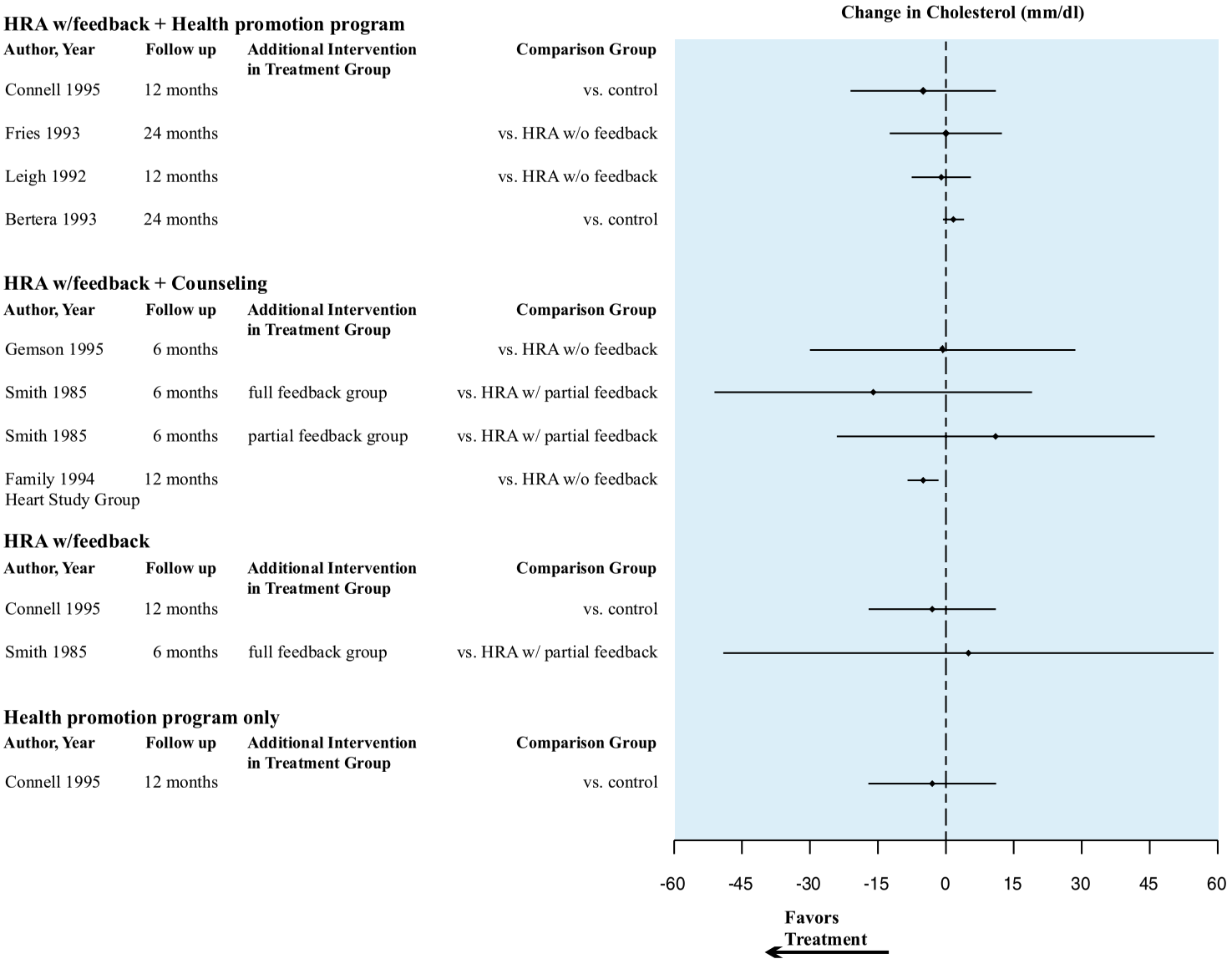
Seven additional studies assessed blood pressure. Of these, 4 reported a beneficial effect of interventions incorporating an HRA. For example, Clifford and colleagues[57] reported in a small study that the average drop in blood pressure for intervention participants was from 84.5 to 74.5mm Hg for diastolic blood pressure and from 135.8 to 124.7mm Hg for systolic blood pressure.

Figure 5. Forest Plot of Systolic and Diastolic Blood Pressure Studies



Cholesterol. We identified 7 controlled studies of HRA interventions that measured serum cholesterol reduction. Figure 6 plots the difference of differences for cholesterol for the 11 comparisons reported in these seven studies. Underneath the horizontal axis on each plot we note the direction that "favors treatment." We also provide a vertical line at the relevant reference point (zero for difference of differences) that indicates where the intervention and control are equitable in terms of that outcome. No clear pattern of effectiveness is apparent. The most promising application of HRA was reported in the Family Heart Study.[43] In that study, Spilman and colleagues reported that at follow-up of 12 months, the cholesterol levels of intervention participants were lower than those of controls by an average of 0.1 mmol/L, a difference of borderline statistical significance.

Figure 6. Forest Plot of Cholesterol Studies



BMI/ Weight/ Body Fat Studies. Beneficial effects were found in 7 of 16 controlled studies investigating changes in BMI, weight, or body fat. For example, Clifford and colleagues[57] found that intervention participants reduced their weight by an average of 6.6 lbs. over 12 months, whereas the weight of control group participants remained stable. The Family Heart Study[43] found differences between the intervention and control groups of about 2.2 lbs. at follow-up. Both Logsdon and colleagues[53] and Erfurt and colleagues[61] found that those involved in a more intensive intervention had a greater chance of losing weight compared to those who completed only an HRA (Logsdon: 38% vs. 25% lost at least 5 pounds over 10-12 months; Erfurt: more than 25% vs. 17% lost at least 10 pounds over 3 years). The differences among studies in measurement of the outcome precluded us from summarizing their results in a forest plot.

Health status outcomes

Eleven controlled studies investigated whether HRA interventions affected health status. (Again, one study that did not directly test for differences between the control and interventions groups[54] is not further considered in this section.) Health status was assessed in a wide variety of ways and precluded the use of a forest plot. Assessments used in more than one study included HRA risk age (n = 5), general health status (n = 3), number of sick or disability days (n = 3), risk of heart disease (n = 2), risk of cancer (n = 2), and mortality risk (n = 2). HRA risk age is an overall measure of the risk level of a participant as compared with the average person of the same age, sex, and other fixed characteristics.[39] All three studies that included a measure of general health status found a beneficial effect,[5, 7, 56] as did three of the studies assessing HRA risk age.[57, 60, 62] One study found that an HRA intervention resulted in a drop of 0.8 sick days per 6

months for retirees,[7] although two others did not find that participating in an HRA intervention reduced sick or disability days.[56, 63]

Psychological outcomes

Seven controlled studies investigated the effects of HRA interventions on various aspects of psychological functioning. Distress measures used in more than one controlled study include anxiety (n = 2), anger (n = 2), depression (n = 2), and stress or tension (n = 4). Five of these studies found positive effects of an HRA intervention on some aspect of psychological functioning. Two studies each found positive effects of an HRA intervention on stress or tension[7, 57] and depression.[5, 6]

QUESTION 2 AND 3. *What is the value of different levels of intensity in follow-up (e.g., a self-management book vs. a self-management book and nurse follow-up phone calls or community referrals)? What are the key features of HRA surveys and follow-up interventions?*

To further evaluate the effectiveness of programs using HRA, we classified each intervention in terms of intensity. The least intensive interventions involved providing HRA feedback to participants (sometimes combined with providing standard educational materials). More extensive interventions involved providing HRA feedback with some type of supplemental counseling from a physician, health educator, or other individual. The most extensive interventions provided HRA feedback plus the opportunity to participate in a health promotion program. Within these broad categories, considerable variation exists across studies in the extent of involvement in the intervention, availability of materials and programs to participants, and length of follow-up. However, the data suggest that more intensive interventions yield better results.

Feedback Only. Ten controlled trials included a group that received HRA with feedback only. Four of these studies compared the "HRA feedback only" group with either: a) a group that did not complete an HRA; or b) a group that completed an HRA but did not receive feedback. These studies found very limited benefit from HRA feedback alone on the health parameters under investigation.

Lauzon found a significant positive effect of HRA feedback on alcohol consumption, breast self-exams, exercise, and health risk age.[60] However, in no case was a beneficial effect of HRA feedback on these behaviors consistently found across all gender and age groups. For example, among males aged 30-40 only, a higher percentage of participants in the feedback group than control group made positive changes in their alcohol habits than did those in the control group (high-risk participants: 33% vs. 12%, respectively; low-risk participants: 16% vs. 0%, respectively). Among females aged 41-55 only, a higher percentage of participants in the feedback group made positive changes in their breast self-exam habits than did the control group (high-risk: 21% vs. 9%; low-risk: 28% vs. 8%). Among males aged 41-55 only, a higher percentage of participants in the feedback group than control group made positive changes in their exercise habits (high-risk: 63% vs. 31%; low-risk: 17% vs. 0%). The Lauzon study did not find significantly greater improvements in health behaviors among those who received HRA feedback on smoking, seat belt use, obtaining a pap smear, obtaining a rectal exam, weight, blood pressure, and anxiety.

Kreuter and Strecher reported that individuals who received HRA feedback with individually tailored behavior change information were more likely to get a cholesterol test than were those who received no feedback (53% vs. 40%), although individuals in a third group that received HRA feedback without the individually tailored behavior change information were less

likely than either of these groups to get a cholesterol test (28%).[55] Further, group differences were not found on any of the other health-related variables (smoking, diet, exercise, seat belt use, obtaining a mammogram, obtaining a pap smear).

A study by Connell and colleagues indicated that receiving HRA feedback was associated with lower systolic blood pressure and BMI, but not diastolic blood pressure or cholesterol at follow-up (actual blood pressure and BMI values are not presented).[51]

Finally, Nice and Woodruff did not find any differences between participants who received HRA feedback and those who did not complete an HRA on any of the health parameters under investigation: smoking, alcohol, exercise, traffic-related risk behavior, substance use risk behavior, accident control, or wellness maintenance and enhancement.[52]

Feedback plus counseling. Eleven controlled studies investigated the effects of receiving HRA feedback plus counseling. The feedback was provided by a physician in five studies [41, 50, 53, 58, 62] and by a nurse in two studies.[43, 60] Other studies referred to the counselor as a "health educator"[50, 51] (note that the study by Johns had two counseling conditions) or did not specify the background of the counselor.[42, 64] One study that provided group counseling to participants did not provide information on the background of the counselor.[59]

The strongest evidence for the beneficial effect of HRA plus counseling comes from two studies of patients by Logsdon and colleagues and the Family Heart Study Group.[43, 53] The intervention implemented by Logsdon and colleagues involved more structured and extensive physician counseling than most other interventions involving counseling.[53] As stated by the authors (p. 250): "A model of preventive medical services was developed from guidelines in the medical literature and consensus standards of committees expert in pediatric, obstetrics-

gynecology, family practice, and internal medicine. These reports and recommendations were merged into protocols… [that] contained age- and sex-specific medical screening procedures and patient education and counseling techniques for behavioral risk reduction. The intervention at the study sites involved the physicians' use of prevention-oriented encounter forms for recording the patients' risk history and providing the physical examination, clinical laboratory tests, radiologic studies, and immunizations that were indicated according to the clinical findings and the protocols for well patients." Physicians received initial training on the protocol and participated in continuing medical education (CME) seminars in order to review the protocols, discuss problem cases, and present feedback on study patients. Among those who were initially found to engage in risk behavior, a significantly greater percentage of individuals who received physician counseling changed their health behaviors than those who only completed the health screening. These behaviors included starting to exercise (34% vs. 24%), beginning to use seat belts (23% vs. 8%), losing at least 5 pounds (38% vs. 25%), reducing heavy drinking (33% vs. 21%), and beginning monthly breast self-exams (51% vs. 19%). A group difference was not found for smoking cessation.

The Family Heart Study was a large national trial of a nurse-led cardiovascular screening and lifestyle intervention.[43] In an effort to engage the entire household in behavior change, the protocol offered screening to couples (rather than individuals) and used a family-centered approach to counseling. The initial screening took 1-1/2 hours to complete. Follow-up assessments occurred every 2, 3, 4, 6, or 12 months depending on the individual's level of risk. At the end of the 12-month follow-up period, the group that received counseling had a 4% decrease in smoking, a 7mm Hg decrease in systolic blood pressure, a 3 mm Hg decrease in diastolic pressure, a 2.2 lbs loss of weight, and a 0.1 mmol/L decrease in cholesterol

concentration compared with the control group. A group difference was not found for blood glucose level.

Gemson and Sloan[62] found that individuals who completed an HRA and received physician counseling increased their self-reported engagement in exercise over a 6-month period compared to those who completed an HRA only, but did not significantly differ on changes in measured weight, systolic blood pressure, or cholesterol.

Connell and colleagues compared a group that completed an HRA and received counseling with a group that completed the HRA but received no counseling.[51] Those who received counseling improved significantly more on systolic pressure and BMI, declined more on exercise, and did not differ on diastolic blood pressure and cholesterol levels when compared with those who did not receive counseling.

Lauzon found significantly greater improvements among those who received feedback plus counseling compared to feedback alone on alcohol consumption, breast self-examinations, and health risk age.[60] However, in no case was a beneficial effect of feedback plus counseling consistently found across all gender and age groups. For example, among high-risk males aged 30-40, a higher percentage of participants in the counseling group than feedback alone group made positive changes in their alcohol habits (50% vs. 30%, respectively). Among high-risk females aged 41-55 only, a higher percentage of participants in the counseling group than feedback alone group made positive changes in their breast self-exam habits (38% vs. 21%, respectively). Lauzon did not find significantly greater improvements among those who received feedback plus counseling on smoking, exercise, seat belt use, pap smear, rectal exam, weight, blood pressure, and feelings of anxiety.[60]

Several of these studies found no effect[58, 64] or effects on a very limited number of the health parameters under investigation.[41, 50] One study found that participants who received counseling and those who received counseling plus monetary incentives for behavior change had higher smoking cessation rates and smaller increase in BMI than did two groups that did not receive counseling.[42] However, no differences were observed between the "counseling" and "no counseling" groups in terms of changes in percent body fat, blood pressure, cholesterol, or aerobic capacity. Further, it is not clear from these results whether counseling alone, without additional monetary incentives, has beneficial effects on these health parameters.

Feedback plus health promotion programs. Fourteen controlled studies combined HRA feedback with the opportunity to engage in a health promotion program. As the following examples illustrate, these programs had varying degrees of actual participation. Bamberg reported that 94% of employee participants attended all 6 of the programs offered.[65] Clifford and colleagues found that the average percentage of sessions attended by YMCA participants ranged from 65 to 85% for standard treatment sessions and 31 to 60% for standard follow-up sessions, depending upon condition.[57] Further, participants who were offered additional counseling by a therapist attended an average of 70% of the sessions, whereas participants offered additional peer problem-solving sessions attended an average of only 10% of the sessions. Spilman and colleagues reported that, depending upon location, 70% and 82% of employee participants completed at least 1 of 9 health education modules that were offered.[56] Patrick and colleagues found that more than 80% of Medicare participants attended core intervention classes on exercise and nutrition, whereas attendance at non-core classes ranged from 17% (seat belt use) to 76% (home safety).[5]

Many of these programs showed initial promise. Research is needed to understand the long-term effectiveness of HRA interventions that use feedback and health promotion programs.

Randomized Controlled Trials. Five RCT studies showed significant benefits of combining HRA with participation in a health promotion program. Each of the studies focused on older adults. Participants in four of the studies were Medicare beneficiaries, whereas the fifth study involved Bank of America retirees.

Mayer and colleagues found significantly greater improvements among individuals who completed an HRA and were offered an 8-week health promotion workshop than among those who completed an HRA and received usual care, on a number of health-related parameters at 12-month follow-up.[3] Specific beneficial effects included increased time spent in stretching (average increase of 4 minutes per week) and strength exercises (average increase of 7 minutes per week), decreased fat intake and caffeine intake, and increased metabolic rate. However, no differences were found in dietary variety, fiber intake, meal regularity, home safety, motor vehicle safety, BMI, and blood pressure. At the 24- and 48-month follow-ups, the beneficial effects of the intervention remained for stretching exercises and metabolic rate.[4]

In a study of Medicare beneficiaries, Patrick and colleagues compared "usual care" to that of a package of preventive services that included HRA, health-promotion visit, disease-prevention visit, and follow-up classes.[5] At the 24-month follow-up this study found that the intervention group showed significantly greater improvement than the control group on the following health-related parameters: physical activity (27% vs. 21% improved, respectively); receiving flu shots (17% vs. 12% improved, respectively; quality of life; global health status; depression; and health worry. At the 48-month follow-up the effects for flu shots; depression;

and health worry remained. Group differences were not found for other health-related behaviors: smoking; alcohol; diet; seat belt use; home safety; medication awareness; breast self-exam; BMI; total health care costs; and stress.

A study by Williams and colleagues on Medicare beneficiaries utilized HRA feedback by a health educator, educational materials, an 8-week workshop, booster telephone calls, and a newsletter.[6] After four years, the intervention group showed greater improvements in metabolic rate (from 379 to 432), self-reported stretching activity (from 15 to 20 minutes per week), depression, and immunization rates compared to a group who completed an HRA only. Differences were not found on diet, BMI, or blood pressure.

Articles by Burton[44] and German[45] also reported on an intervention for Medicare beneficiaries. Participants in the intervention received an explanatory letter and voucher for a visit without charge to their primary caregiver at Year 1 and Year 2. Physicians were asked to: review health risks; provide counseling where appropriate; take a complete medical history; and include breast, pelvic and rectal exams in the physical exam. Lab tests and immunizations were also provided. After two years, the intervention group did not significantly differ from the control group on smoking, problem drinking or sedentary lifestyle. However, the health of participants in the intervention group declined less compared to the control group, as measured by the Quality of Well-Being Scale. This difference was mostly due to a differential death rate between groups.

Leigh and colleagues reported on the effects of a 12-month intervention called Healthtrac among a group of Bank of America retirees.[7] Of the interventions we reviewed, Healthtrac is the only one delivered exclusively through the mail. Participants in this study completed an HRA

and received feedback every 6 months. The feedback consisted of a personalized risk report and recommendation letters (based on the HRA), newsletters, books, and other materials. Compared to a control group who completed an HRA but did not receive feedback, intervention participants showed greater improvement on several self-reported dietary habits (servings of fat, salt, whole-grain breads and cereals, fiber, eggs, and cheese), but not on others (servings of fruits, vegetables, calcium-rich foods, red meat, and butter). Intervention participants reported greater improvement on all health status variables (such as health risk score, global health status, sick days, and disability/illness) except arthritis. Further, intervention participants reported greater improvement on several psychological variables (feeling rushed, angry and stressed), although group differences were not found on tenseness or tranquilizer use. With the exception of seat belt use, behavioral variables (smoking, alcohol use, or exercise) and physiological variables (weight, diastolic or diastolic blood pressure, or cholesterol) showed no group differences.

Controlled Before-After Studies. Clifford and colleagues found that individuals who participated in a year-long intervention that involved group meetings on a variety of health issues showed significantly greater improvement on exercise, several physiological variables, and health status than did individuals who received only physical assessment feedback (weight, body composition, cardiovascular fitness, and blood pressure).[57] However, this study is limited by the select nature of the sample (YMCA members) and sample size (11-14 in each condition).

Spilman and colleagues compared individuals who were and were not offered health education classes on a wide range of behavioral, physiological, health status, and psychological variables.[56] (The authors report p-values with no additional information on which to evaluate effect sizes except for effects on smoking.) Effects of the intervention over a 12-month follow-up on smoking, exercise, weight, blood pressure, cholesterol, and global health status were

significant. It should be noted that these effects tended to be limited to only one of the two intervention sites or were only found among intervention group members who actually participated in the health education classes.

Bertera focused exclusively on mean disability days.[63] Intervention participants received assistance in interpreting their HRA results, and had the following health-promotion activities available: four- to ten-week classes; a bimonthly health and fitness magazine; challenges and incentive programs for health behavior change; health foods in vending machines; and machines and scale available for employees to check their blood pressure and weight. Results indicated that mean disability days lost by hourly employees were reduced by 0.7 in program sites and 0.3 in non-program sites over a two-year period.

Blair and colleagues,[47] Shipley and colleagues,[48] Weinstein and colleagues,[49] and Wilbur Garner[46] all reported results from Johnson and Johnson's Live for Life program. Participants completed a health screening and 3-hour lifestyle seminar to introduce the program. Lifestyle improvement programs were available and, in some locations, employees were given the opportunity to exercise at company-provided fitness facilities. Incentives were offered to reward participation and encourage program involvement. These studies reported greater changes in the intervention group compared to those who just completed the health screening on smoking cessation, exercise, seat belt use, weight, and general well-being (but not blood pressure).

Controlled Clinical Trials. A study by Erfurt and colleagues[61] compared four interventions of increasing intensity: Group 1 completed an HRA, and high-risk employees received referrals; Group 2 added health education materials and classes to the intervention received by Group 1; Group 3 added follow-up counseling to the intervention received by Group

2; and Group 4 added worksite modifications (health communication networks, peer support groups, facility-wide health promotion activities) to the intervention received by Group 3. Overall differences among groups were found for each of the four health parameters investigated: smoking; weight; diastolic blood pressure; and systolic blood pressure. Further, comparisons of Groups 3 and 4 vs. Groups 1 and 2 found greater improvements among participants in Groups 3 and 4 on these parameters. Although improvements on the health parameters tended to increase with more intensive interventions, further subgroup comparisons were not reported.

Gomel and colleagues compared two groups of participants who received either a health risk assessment or health education with two groups of participants who received behavioral counseling.[42] Members of one counseling group were offered up to six lifestyle counseling sessions over a ten-week period. Participants in the other counseling group were provided with a lifestyle change manual and offered a goal-setting and follow-up counseling session, as well as a range of monetary incentives for behavior change. (Please note that these counseling interventions are more involved than the single-session counseling characteristics of the other counseling studies we reviewed. Given the more intensive nature of the Gomel's intervention, we have chosen to discuss the study here, rather than in the section on "feedback plus counseling.") These groups were compared on the following health parameters: smoking; BMI; body fat; blood pressure; cholesterol; and aerobic capacity. Participants who received counseling had higher continuous smoking cessation rates, and showed less increase in BMI, compared to participants who received no counseling. However, no differences were observed in the other parameters. It is not clear from these results whether combining counseling with monetary incentives results in greater health-related changes than does offering counseling alone.

The researchers compared the effects of the incentives on only one parameter, blood pressure, with individuals who received counseling alone showing a greater decline in blood pressure than those who also received monetary incentives.

QUESTION 4. *Do the HRA interventions appear to reduce health care costs by reducing disease and utilization of services?*

Assessing the cost-effectiveness of programs that use HRA must address four issues: 1) Are the health promotion or disease prevention (HPDP) programs themselves cost-effective? 2) Is HRA a cost-effective tool to achieve the goals of the programs? 3) How can HRA be used in a cost-effective manner in HPDP programs to improve health or prevent diseases? 4) Does the intervention appear to reduce health costs by reducing disease and utilization of services? Unfortunately, to date, no studies have addressed these specific issues definitively. Moreover, existing studies are difficult to compare for the following reasons:

- Heterogeneous research designs
- Heterogeneous HRA implementation
- Wide range of multi-component interventions
- Differential effectiveness on various populations (e.g., middle aged vs. seniors)
- Various definitions and measurements of program costs and effectiveness

In addition, it is impractical to compare the programs that use HRA collectively with other single-factor prevention programs and medical treatments such as smoking cessation and hypertension interventions.

In an attempt to respond to the questions regarding cost effectiveness, we first reviewed the cost-effectiveness of a series of HCFA-funded programs that collected HRA information and provided health promotion or disease prevention services to Medicare beneficiaries. We then

reviewed several programs that provided sequential feedback of HRA information to program participants including seniors. Finally, we summarized the cost-effectiveness results for worksite-based programs. These three sections are summarized in Table 4.

Table 4. Cost-effectiveness of programs using HRA

Type of program	How HRA info used	Costs/ Participant	Effectiveness	Reference
COBRA: comprehensive coverage for disease prevention and health promotion services provided to elderly Medicare beneficiaries.	Data collected and analyzed but status of feedback and follow-up evaluation unknown.	$159 to $306 (2 years) (1994 values).	Changed some health behaviors that involved minimal effort; some short term health improvement demonstrated in some programs; HRAs applied with limited intervention intensity and of uncertain effectiveness for older adults; did not produce Medicare cost-savings as implemented in these demonstration programs.	Burton, 1995a; Elder, 1995 ; German, 1995; Lave, 1996 ; Morrissey, 1995 ; Patrick, 1999; Schweitzer, 1994; Williams, 1997
Healthtrac: Sequential HRA; intervention participants received HRA reports, personalized recommendations, self-management and educational materials.	Data collected and analyzed by computer program. Participants received periodic graphic summary of HRA reports, and recommendations.	Approximately $100 for higher risk participants (per year), $30 for all others.	Improvement in health risk scores; self-reported change in some health behaviors (such as smoking, diet, alcohol; exercise; cholesterol; and reported stress); reduction in self-reported medical utilization; reduction in medical costs.	Fries, 1992; Leigh, 1992; Fries, 1993a; Fries, 1993b; Fries, 1998
Nine worksite-based and one home-based health promotion programs.	Implemented in a wide variety of manners. In some programs HRA was key intervention and in others HRA was neglected or used for non health promotion purpose.	Cost varied widely: no consistent method used for imputing intervention costs.	Majority of the studies showed positive cost-effectiveness results and some demonstrated cost-beneficial or positive ROI estimates. However, no attempt to demonstrate the impact of programs or HRA on results.	Acquista, 1988; Bertera, 1990; Erfurt Holtyn, 1991; Gibbs, 1985; Golaszewski, 1992; Harvey, 1993; Hornsby, 1997; Ozminkowski, 1999; Reed, 1986; Sciacca, 1993

COBRA = Consolidated Omnibus Budget Reconciliation Act
HRA = Health Risk Appraisal
ROI = Return on Investment

Medicare Prevention Demonstration

In the late 1980s, the Health Care Financing Administration (HCFA) funded six demonstration programs to evaluate the cost and effectiveness of comprehensive coverage for disease prevention and health promotion services to elderly Medicare beneficiaries. Among them was an investigator-initiated 6-year prevention demonstration[8] and five congressionally-mandated 4-year programs called the Consolidated Omnibus Budget Reconciliation Act (COBRA) Medicare Prevention Demonstration.[4-6, 9, 10, 44, 45, 66] The investigator-initiated project was conducted by the University of North Carolina. The COBRA Medicare Prevention Demonstration was carried out by investigators at the University of California at Los Angeles, Johns Hopkins University, University of Pittsburgh, University of Washington, and San Diego State University. The demonstration required all projects to conduct health risk appraisal interviews with project participants. In addition, all projects randomized participants to a control group that received usual care and an intervention group that received newly waived disease prevention services (such as immunizations and health risk screenings) and health promotion/education services (such as nutrition and exercise workshops, and alcohol and smoking cessation counseling). Other than those two common program designs, the projects differ in almost every aspect. For example, the latter two universities implemented the projects in HMO settings while the remaining three universities implemented the projects in fee-for-service systems. Each site used the information collected in the HRA in different ways. Other differences included waivered service packages, socio-demographic characteristics of the participants, methods of recruitment, types of geographic area covered (urban, rural), research design, and measurement issues.

As part of the COBRA demonstration HCFA also funded an independent contractor, Abt Associates Inc., to conduct a cross-cutting evaluation across projects. The evaluation estimated that the average expenditures per intervention participant ranged from $159 in Pittsburgh to $306 in Washington, which reflected the number of project participants, utilization of services, and reimbursement rates among other factors.[2] However, according to Patrick and colleagues,[5] the Washington site received a capitation rate of $186.03 per year for the two-year preventive-services package as well as $20 for each baseline health-risk assessment conducted for treatment-group participants. It is not clear whether the difference between expenditures and capitation rate could be attributed to medical inflation (at the rate of 6.5% for four years). As for the overall effects of the prevention demonstration, the evaluation found short term improvements in health behaviors and health status for some projects, but not savings in Medicare expenditures.

Many issues have been raised and explanations offered for the apparent lack of cost savings from the Medicare demonstration. These included the uncertain effectiveness of particular prevention interventions in older adults, insufficient length of follow-up period, limited intervention intensity, and non-representative sample of Medicare beneficiaries.[2, 4, 5, 8-10]

As for the second and the third questions regarding HRA, we are reluctant to draw any conclusion from these projects. In fact, the role of HRA itself as a health promotion tool was overlooked inadvertently in the demonstration, although all projects collected HRA data. As mentioned in the Introduction section, HRA is part of a systematic approach to promote health through four interconnected stages: data collection, data analysis, feedback/follow-up, and evaluation. The provision of feedback/follow-up is an essential component of HRA because it is

believed that feedback and follow-up interventions will influence the individual to modify health behaviors. However, it is not clear whether the COBRA projects provided feedback of the HRA information directly to participants. Some projects provided the HRA information to participants' physicians or trained nurses without assessing whether the providers actually discussed the HRA with the participants. Thus, the results of the COBRA demonstration cannot be used to assess the cost-effectiveness of HRA.

The HRA information can be expensive to collect. For example, the Pittsburgh site spent one-ourth ($116,520) of its total project cost ($506,313) to collect the HRA information. Failure to use such information as a health promotion tool could impede the success and the cost-effectiveness of the health promotion programs.

Sequential HRA Programs - Healthtrac

Four studies of the Healthtrac program described earlier[7, 11-14] examined cost-effectiveness. The standard intervention consisted of a sequential time-oriented HRA followed by a health-promotion package through the mail every six months. The package included serial personal health risk reports and feedback of progress in behaviors/outcomes from prior time periods, personalized recommendation letters tailored to individual health risks, and self-management materials and other educational materials specific to identified risks. One study[14] implemented a more intensive intervention to higher risk individuals: a similar package to the standard one was delivered but in three-month instead of six-month cycles. The cost of the intervention averaged $30 per participant per year in all studies; except for the latter one, where the cost for the higher risk group was about $100 per year. Unlike the COBRA demonstration, where the interventions provided coverage for preventive services, no clinic visit or service costs

were included in program costs. Thus the intervention costs were substantially lower than those in the COBRA demonstration.

As discussed earlier, all the Healthtrac studies revealed certain positive intervention effects: improvement in health risk scores; self-reported change in some health behaviors (such as smoking, diet, alcohol, exercise, cholesterol, and reported stress); reduction in self-reported medical utilization; and reduction in medical costs. In addition, all studies included older adults and the results showed that changes in this population were as great as those in younger adults. The study that targeted a higher-risk group with more intensive interventions found that preliminary return on investment (ROI) at a six-month follow-up was approximately 6:1 for the higher-risk group compared with 4:1 for the lower-risk groups.

The lack of agreement between the results of the Healthtrac studies and those of the COBRA demonstration could be attributable to at least three possible factors. First, the sequential feedback of HRA information along with individualized recommendation letters and self-management and educational materials provided by Healthtrac may encourage health behavior modification. Second, on-going interventions help sustain program effects. Healthtrac sent sequential HRA interventions to its participants every six months through the end of the evaluation period. In contrast, COBRA demonstration interventions were implemented for two years, but discontinued two years prior to the end of the evaluation period. Many positive behavioral or health status outcomes observed after two years disappeared by the four-year follow-up. Third, Healthtrac's sequential HRA interventions were community-based programs that reached much larger samples than did the practice-based COBRA demonstration. Larger sample size is more likely to allow results to achieve statistical significance.

The results achieved with Healthtrac's sequential HRA interventions of tailored feedback and recommendations along with cues to action (self-management and educational materials) suggest that programs that use HRA with feedback and interventions are cost-effective. However, as the investigators for Healthtrac themselves note, there are several limitations to their studies.[7, 12] These include low participation rate among those eligible (about 60%) and higher than desired attrition rates among persons participating in the study (about 20% at 1 year); the reliance on self-reported outcomes; and the lack of Medicare claims data and knowledge about deductibles, coinsurance, and noncovered medical expenses, making it impossible to determine if a reduction in total medical care costs was achieved. Furthermore, the Healthtrac studies were conducted within the context of a research program; whether similar results could be achieved in the context of a Medicare-based administrative system is worth study.

Worksite-based Programs

Extensive reviews of the outcomes of worksite-based Health Promotion-Disease Prevention (HPDP) programs have supported the clinical effectiveness and cost-effectiveness of such programs.[67-72] According to the reviews, some empirical evidence supports the effectiveness of HRA for participating employees.[38, 73, 74] The results of our review of nine worksite-based and one home-based programs are consistent with those findings.

Overall, eight of the ten studies showed favorable cost-effectiveness results for the evaluated programs.[15-17, 63, 75-78] The remaining two studies, which examined the same worksite health promotion program, reached opposite conclusions. While a cohort analysis by Reed and colleagues suggested that participation in the program reduced health care utilization and resulted in health cost savings,[79] Sciacca and colleagues found no reduction in health care costs.[80] The two analyses differed in a number of ways, including 1) outcome measures, 2)

methods of data analysis, 3) strategies for reducing the skewness of the data, 4) study time periods, and 5) composition of the study groups.[80]

These worksite-based studies generally did not use a randomized controlled design and occasionally did not have a control group, which call into question the internal validity of the studies. In addition, the worksite-based programs were offered only to employees and not retirees. Thus, the generalizability of the programs to the senior population is unknown. HRA was used in various ways in the programs, ranging from an analytic tool for projection purposes[15] with no indication of its implementation or impact[16] to a core intervention for health management purposes.[17]

Cost-effectiveness of the programs also varied widely, as investigators used different definitions and methods to calculate program costs associated with changes and different definitions of effectiveness. Each of the studies assessed only a limited range of program impact and thus provided no evidence to assume that cost savings was the result of program participation. For example, one small-business study found that the success of HRA and health promotion programs in worksites was associated with a company's financial support.[76] A university-based study provided preliminary evidence that HRA along with feedback were important factors in health behavior change. However, the study had a 61% attrition rate.[78] A home-based nurse visit program that used HRA to identify participants' health risk profiles found significant risk reductions at one-year follow-up; however, the study had no control group.[75]

Three worksite-based health promotion programs that used HRA revealed a positive return-on-investment (ROI).[17, 63, 77] However, no systematic investigation was conducted to

build the causal linkage from program participation and HRA implementation to attitudinal, behavioral, risk reduction, and finally cost-saving outcomes.

We briefly summarize the programs that demonstrated positive return-on-investment (ROI). One study used HRA to identify participants' health risks and, based on the results, offered or referred them to appropriate intervention programs.[77] Over a five-year period, the healthcare costs of the intervention group were two-thirds those of the cohort control group. Another study provided a health promotion program to blue collar employees and evaluated the impact of the program on absences.[63] Health risk appraisal was implemented on a voluntary basis, and appraisal results were provided in groups and individually upon employee request. The program evaluation demonstrated a ROI of $2.05 by the end of the second year due to savings on disability costs.

Citibank, N.A. initiated a health management program in 1994 and used a quasiexperimental non-randomized design to compare medical expenditures before and after the intervention for program participants and nonparticipants.[17] A $10 incentive was offered to employees to complete HRAs and the results were used to identify employees at high risk, that is, with specific conditions such as asthma and high blood pressure. These individuals were offered health promotion interventions similar to those offered by the sequential HRA programs for high-risk individuals mentioned previously.[14] After an average of 38 months follow-up, the ROI was estimated to be between $4.56 and $4.73 saved (depending on the discount rate applied) per dollar spent on the program. The high ROI could be attributable to the implementation of a well-designed low-cost program, relatively high participation rates, and focus of the intervention on a high-risk population. However, many methodological issues raised earlier, including non-randomized controlled design, lack of evidence for a direct effect of

HRA, variability of ROI imputation, data source limitation, and employee turnover rate, threaten the validity and generalizability of these positive cost-effectiveness findings.

In summary, current literature is insufficient to accurately estimate the cost effectiveness of programs using HRA. Limited evidence suggests that a carefully designed program that uses a systematic approach to implement HRA and subsequent disease prevention/health promotion interventions has the potential to be cost-beneficial. Considerable effort is needed to optimize program design, implementation, and evaluation.

QUESTION 5. *Does the evidence suggest that HRAs should be delivered to the whole population or subsets, such as high-risk individuals?*

With the exception of mentioned studies involving older adults, we found limited evidence on which to evaluate the effectiveness of HRAs in vulnerable populations. No study specifically investigated the effectiveness of HRA across racial/ethnic groups and only two uncontrolled studies included a predominantly minority sample.[81, 82] The only studies that tailored the HRA intervention to the needs of participants at high risk for health problems were those that used the Healthtrac Program. Although results indicated an 11% decline in health risk scores (from baseline) at a 6-month follow-up, this study did not include a control group of high-risk individuals who did not receive the full Healthtrac Program.[14]

QUESTION 6. *What are special variations of HRAs for the older adult population?*

Five controlled interventions with older adults provided outcomes. As discussed previously, the Senior Healthtrac intervention with Bank of America retirees[7] was administered through the mail over a 12 month period, with feedback consisting of a personalized risk report and recommendation letter. Other materials, such as books and newsletters, were also mailed to participants. Participants completed an HRA and received feedback every 6 months. Compared

to a control group who completed an HRA but did not receive feedback, intervention participants showed greater improvement on certain self-reported dietary habits. Intervention participants reported greater improvements on all health status variables except arthritis. Further, intervention participants reported greater improvement on several psychological variables. With the exception of seat belt use, behavioral variables and physiological variables showed no group differences.

One of the previously mentioned COBRA demonstrations, a randomized controlled trial, offered Medicare beneficiaries clinical tests and immunizations, HRA with counseling, and an 8-week health promotion workshop.[3] Participants were compared to a group who completed an HRA (without feedback) and received usual care. The program had beneficial effects on stretching exercises, strength exercises, fat intake, fiber intake, caffeine intake, and metabolic rate. However, no differences were found in dietary variety, meal regularity, home and motor vehicle safety, BMI, and blood pressure. By the 24- and 48- month follow-up, the beneficial effects of the intervention remained for stretching exercises and metabolic rate.[4]

Another COBRA demonstration[5] compared Medicare beneficiaries who received usual care to those who received a package of preventive services that included a) HRA; b) health-promotion visit; c) disease-prevention visit; and d) follow-up classes. This study was also an RCT. At the 24-month follow-up, the intervention group showed significantly greater improvement than did the control group on physical activity, receiving flu shots, quality of life, global health status, depression, and health worry. Only the effects for flu shots, depression, and health worry remained at the 48-month follow-up. No group differences were found on a variety of other health-related parameters at either follow-up: smoking, alcohol, diet, seat belt use, home safety, medication awareness, breast self-exam, BMI, total health care costs, and stress.

In a third COBRA demonstration,[6] participants in the intervention received HRA feedback by a health educator, educational materials, an 8-week workshop, booster telephone calls, and a newsletter. After four years, the intervention group showed greater improvements in metabolic rate, self-reported stretching activity, depression, and immunization rate compared to a group who completed an HRA only. Group differences were not found on diet, BMI, or blood pressure.

The last RCT is also a COBRA demonstration project.[44, 45] Participants in the intervention received an explanatory letter and voucher for a visit without charge to their primary caregiver in Year 1 and Year 2. Physicians were asked to: review health risks; provide counseling where appropriate; take a complete medical history; and include breast, pelvic and rectal exams in the physical exam. Lab tests and immunizations were also provided. After two years, the intervention group did not significantly differ from the control group on smoking, problem drinking, or sedentary lifestyle. However, the health of participants in the intervention group declined less compared to the control group, as measured by the Quality of Well-Being Scale. This difference was mostly due to a differential death rate between groups.

Despite the dearth of randomized controlled trials, a variety of Health Risk Appraisal/ Assessment tools targeted to seniors currently exist. Some are available commercially, while others have been used only in research. Tools available as of June 2000 are described below.

Assessment Tools

Senior Healthtrac. Developed by James Fries, Stanford University. This program, based on self-efficacy theory, consists of completing health risk questionnaires at six-month intervals. Computer-based serial personal health risk reports are provided every six months, along with

individualized recommendation letters, newsletters, self-management and health promotion books, and other program materials. The instrument contains 14 modules on various health risks and major chronic diseases.

HRA – Older Adults. Available from the Healthier People Network, Decatur, GA. This organization continues work begun by the CDC and supported by the Carter Center in the late 1980s. Questions are divided into eight modules on various health risks. Where possible, quantitative estimates of risk are calculated. The questionnaire can be completed in less than one hour.

HRA – Elderly. Developed by John Beck, Lester Breslow, and colleagues at UCLA. Items in the questionnaire cover a comprehensive range of content domains relevant to health promotion in the elderly. Reports are generated for participants and their physicians. The instrument was tested recently in senior centers, in a medical practice, and in random community samples.

Interactive Multimedia HRA. Produced by the Oregon Center for Applied Science, Eugene, OR. This tool employs a kiosk system intended for use in medical facilities and senior centers. Based on touch-screen responses, the system creates a report designed to encourage specific behavior change in older adults.

Personal Wellness Profile – Senior Edition. Available from Wellsource, Inc. Clackamas, OR. Targeted primarily towards healthy individuals, this instrument is used by some Medicare HMOs for risk data collection. It is usually administered via mail. The 39-item questionnaire takes about 15 to 20 minutes to complete, not including collection of optional clinical test data.

Senior Health Profiles. Available from Geriatric Health Systems, LLC, San Francisco, CA. This tool is used by some Medicare health plans for risk stratification. Risk probabilities are calculated using the nation's largest Medicare risk factor and probability database. Data is collected by mail or telephone.

Summex Senior Health Monitor. Available from Summex Corporation, Indianapolis, IN. Designed for Medicare managed care programs, SUMMEX estimates the length of time to complete the instrument as only 8 to 10 minutes. Covers over 40 health dimensions.

YOU FIRST Senior Health Assessment. Available from Greenstone Healthcare Solutions, Kalamazoo, MI. Detailed, targeted reports aid in increasing the speed with which the primary care provider identifies and acts on clients requiring care and targeting interventions. Includes a 15-item "readiness to change" scale.

Administrative characteristics

Table 5 displays several important characteristics of these senior HRAs. Six are available in Spanish, and four of these six are available in other languages such as German and French. None were available in Asian languages. English reading levels ranged from grade five to grade ten, as measured by the Flesch-Kincaid scale.

Four of the senior HRAs currently use scannable forms. Four have computer screen-based versions. The length of the instruments varies considerably, from a low of 31 items to as high as 200 items. The number of items each client needs to complete varies, because skip patterns are usually determined by the individual's answers to earlier questions on risk behavior. Likewise, the length of a feedback report may vary according to a patient's risk profile, as

patients with more risks will receive a longer report. None of the senior reports are longer than 12 pages, and several have fewer than five pages.

Table 5. Administrative Characteristics of HRAs for Older Adults

Title	Spanish Available	Other Languages	Scannable Forms	Screen-based	Number of items	Reading level (grade)	Length of report (pgs)
Senior Healthtrac	X	X	X	X	32-200	6	2-4
HRA – OA	X	X	X	X	152	5	7
HRA – E	X	X	under development		100+	8	8-12
Interactive HRA				X	80	10	2-5
Personal Wellness Profile – Senior	X		X	X	39	6.3	8
Senior Health Profile	X				31	8	2
Summex Senior Health Monitor	X	X	X		61	6	5
YOU FIRST Senior Health Assessment					32	8	?

QUESTION 7. *What is the role of technology in HRA administration?*

The widespread rise in use of personal computers in the 1980s and the Internet in the 1990s has led to new and innovative ways of administering health information programs. Although in 1998 only 11% of persons 55 years of age and older reported any online/Internet usage,[20] this percentage is predicted to grow significantly in the near future. The use of interactive technology may make the HRA process more efficient, less costly, and more appealing to older adults.

Several promising interactive approaches have been developed in recent years, primarily by commercial firms. Although we found no controlled trials of these approaches, we did find literature on development, implementation, and feasibility issues. We describe these HRA programs below.

Interactive voice response (IVR)

Interactive voice response (IVR) technology refers to an automated telephone conversation system that requires no human operator. Callers respond to questions by using a touch-tone phone key pad. A Massachusetts firm recently created an interactive voice HRA for use in a managed care setting.[18] The package allows for focused and tailored questioning and real-time dynamic feedback. Responses are stored in a relational database and relevant calculations are instantly performed. For example, after a client enters his/her height and weight, the computer calculates Body Mass Index (BMI) and determines obesity status. The system measures various health risks as well as associated stages of change, and provides appropriate recommendations. An evaluation of this HRA showed that 95% of users found the system "easy to use."

Personal computer

With many HRA programs, feedback is delayed due to postal and processing time. However, an interactive computer kiosk or personal computer, can deliver immediate feedback. In the early 1980s, Lynda Ellis, John Raines, and colleagues created a conversational health risk appraisal that used an Apple II microcomputer with only 48 kilobytes of RAM, one disk drive, and APPLESOFT BASIC. Since that time, computer technology has improved tremendously. Decreased size and weight (which increases mobility), increased affordability, and a constantly expanding ability to link to a variety of other media (in particular audio and video) as well as other data sources have greatly enhanced the practicality and versatility of using personal computers to deliver HRAs.

In 1991, Ellis, along with Hwa-Youn Joo and Cynthia Gross, published additional findings on the use of a new computerized HRA. Ellis tested the acceptability of a conversational microcomputer-based HRA among a sample of 247 adult volunteers whose median age was 56 and approximately 44% of whom were 60 years of age or older.[83] The majority of subjects (64%) were female. The HRA was piloted at the Minnesota State Fair and the Senior Options Exposition on both an IBM PC (input only from keyboard) and a Macintosh Plus computer (input only from mouse). All participants waited in a single line and were then directed to the first available computer. After responding to the questions, subjects received (on the screen) a profile of their current health risks, comparison average scores matched by age and sex, and suggestions for reducing their health risks. Printed copies of the assessment were also available. Type of computer interface showed a significant effect on the average length of time necessary to use this particular HRA program (measured at the Senior Options Exposition only): 8.8 minutes for those entering data using the keyboard (n=61) and 11.8 minutes for those who

used the mouse (n=81). Time required to complete this HRA program was also significantly longer for older and female subjects. Significantly more mouse users (9.8%) than keyboard users (1.2%) declined to see the suggested recommendations. While declining to receive the suggested recommendations may inherently limit the usefulness of such HRA programs, the type of computer interface had no effect on either self-reported helpfulness of the HRA or on self-reported intention to change health behaviors. Older users were more likely to report that the HRA was helpful, while both older and female participants reported more intent to change behavior.

A more recent study published by researchers in Japan[84] describes the development of a "Lifestyle Evaluation System" (LES) that runs on a personal computer using Microsoft Excel and Windows 95. This program was designed to target risk groups for certain diseases among men and women from 30 to 60 years of age. The LES allows participants to input data using both the keyboard and mouse. In addition to gathering data from the participant at the time of completing the HRA, the LES also has the ability to link to data stored from previous uses of the LES by the participant, as well as to periodic health check data gathered through Japan's national health care program. These additional data allow the LES to provide feedback to participants regarding their current health risks as well as show any progress made since their last use of the LES and comparisons of the subject's health status to that of others in their community. Results were published for 32 participants only (consisting of public health nurses, patients, students, and a doctor), for whom an average of 8 minutes was required to complete the LES. Of those who completed the LES, 81% found it neither too short nor too long, and 92% found the operation easy or rather easy to use.

In the past few years, Blair Irvine and colleagues have utilized some of the latest technology to develop an Interactive Multimedia Health Risk Appraisal (IMM-HRA). Two immediate differences that distinguish their program from other HRAs are the use of a touch screen interface and the masking of all computer components from view so that only the touch screen is visible. In addition, participant feedback is designed to mimic a one-on-one counseling session through the use of combined audio, video, and printed messages, and the participants' age, gender, and race/ethnicity are matched to that of the actors shown in the video feedback segments. In 1998, Irvine and colleagues reported on the use of this system among a population of 42 older females who participated through a senior center. All participants were Caucasian females over 65 years old (mean age 71.5 years) who were recruited at a senior health fair or had volunteered after seeing flyers or hearing about the project from friends. Efforts were made to remove any potential perception of the computer program as intimidating by using the touch screen interface, hiding all other computer components, and advertising the program as being "like a personal TV program." Participants required approximately 15 minutes to complete the questionnaire section of the HRA and another 5 to 30 minutes to complete the video feedback portion, depending on their number of risks and which options they chose to view. One limitation of this particular trial was that none of the 42 participants reported many health risks. However, the participants reported general satisfaction with the program. Results showed that participants found the program useful, were satisfied with the program, found it easy to use, would recommend it to a friend, and would use the program again if it were available. Other reported measures of satisfaction included that the text was easy to read, the audio was easy to hear, the instructions were not confusing, the program did not make the subjects uncomfortable or frustrated, and the program was neither physically nor emotionally tiring to use.

Irvine and colleagues continue their research in developing the IMM-HRA and are currently conducting a randomized clinical trial on the application of the program to older populations. A strong emphasis remains on the use of the touch screen, the masking of all other computer components from view, and gender and race/ethnicity congruence between participant and video feedback actors. Interactive feedback will also allow participants to access *Age Pages* developed by the National Institute on Aging to receive additional relevant information.

Internet

A Boston-area HMO recently collaborated with a large international employer to create a corporate health promotion plan.[19] The project focused on education, self-care, and individual empowerment. On-site fitness centers and exercise reimbursements were also included. In conjunction with a subcontractor, an interactive web-based health risk appraisal system was created. (A paper version is also available.) The computer system measures stages of change, uses clinical algorithms to assess risk probabilities, and feeds back personalized reports to the employee. To maintain confidentiality, the system allows participation anonymously or by case number identification. The site is password protected outside the company firewall and uses encrypted text transmission (SSL). A clinical coordinator oversees the program, and technical support is available to those who need help completing the form online.

A survey of users reported that all respondents found the site “easy” or “very easy” to use. Sixty-six percent felt the program and reports were valuable, and 50 percent felt it helped them commit to making changes. Results regarding changes in behavior and health status have not yet been published.

Tailoring of materials

One advantage of using health risk appraisals for behavior change is that feedback/ educational materials can be tailored specifically for an individual. Through computer technology, health information and behavior change strategies can be customized on the basis of a person's unique needs. In the past, health education materials were often designed for the general population. For example, pamphlets or letters would be sent via mass mailing. Now, materials are more frequently targeted toward a specific group, for example young women or Latinos. Recent studies have found individually tailored materials to be much more effective than those designed for a broader audience. Campbell and colleagues compared the effects of computer tailored messages with those of nontailored messages on nutrition.[85] Subjects in the tailored group significantly reduced their intake of total fat and saturated fat compared to the control group. In addition, Krueter has conducted several controlled trials of tailored materials and has found them to be effective in areas such as weight loss,[30] physical activity,[86] and utilization of preventive screenings.[55, 87] According to Brug and colleagues, tailored messages are more likely to be recalled at a later date, perceived as interesting, and discussed with others.[88]

Materials can be tailored toward an individual's demographic profile, risk behaviors, and stage of readiness and motivation level. Rosen recently developed an instrument[89] to tailor messages to students' exercise attitude, intent, behavior, and stage of change from Prochaska's transtheoretical model.[90] Krueter and Strecher also personalized materials based on stage of readiness, perceived barriers to exercise, self efficacy for exercise, and beliefs about the health benefits of exercise.[55] Significant changes in physical activity were observed for those who received such tailored materials.

QUESTION 8. *How have issues of confidentiality and privacy been addressed?*

Little has been written about confidentiality issues regarding HRA and related programs. Most HRAs discussed in this report were used in the context of research studies that would require in most or all cases informed consent on the part of the participant and some data safeguarding plan. According to HCFA, expansion of HRAs to the Medicare population could pose problems with respect to confidentiality, as any program involving HRA depends to a considerable extent upon sensitive patient health information. This problem could be addressed by requiring any organization administering HRAs for Medicare to submit a data safeguarding plan similar to that required for research studies. The plan would address the handling, storage, and retention of hard copy and computer-readable versions of the data.

Beyond analyzing the data, the institution administering the HRA program will likely wish to contact the patient to obtain follow-up information. As this may increase the likelihood of disclosure to third parties, the data safeguarding plan should include a protocol for protecting patient confidentiality when contacting patients for follow-up. The institution should limit the number of people who have access to the data, ensure that those who do are aware of and accept their confidentiality obligation, and train them on procedures designed to prevent accidental disclosure during data collection, storage, analysis, and follow-up.

QUESTION 9. *Does the integration of social, public health, and medical approaches enhance healthy aging? Does the opportunity to integrate these three approaches exist through HRAs?*

The first question was dealt with in a recent IOM report entitled *Promoting Health: Intervention Strategies from Social and Behavioral Research.*[1] The thrust of this report was that substantial improvements in prevention and measurement of chronic conditions were unlikely to be achieved without dealing with the social context in which patients live. Integrating social,

public health, and medical approaches is necessary in order to achieve this. HRAs coupled with health promotion programs have the opportunity to be an important part of such integration, by identifying threats to health, providing recommendations tailored to an individual's specific medical and cultural context, and linking this with information on resources available within the community, such as senior centers.

LIMITATIONS

Limitations of this review involve the quantity and quality of available evidence on which to evaluate the effectiveness of HRA. Of the research studies containing outcomes data, only 27 employed a control group. Studies lacking control groups were often underpowered to detect small-to-medium statistical effects although the controlled studies generally had adequate statistical power. Still, these studies tended to rely either heavily or exclusively on self-reported behavioral data, which is susceptible to various sorts of biases. The exception to the tendency to rely on self-report involved measurement of physiological outcomes. Most controlled studies took actual measurements of height, weight, blood pressure, and cholesterol.

The impact of potential recruitment and retention biases on the results is also difficult to evaluate. Of the controlled studies that reported recruitment rates, nearly half indicated that fewer than 70% of eligible individuals agreed to participate. Further, nearly 40% of controlled studies reported retention rates of less than 70% at follow-up. The long-term effectiveness of interventions was often not evaluated, with most studies utilizing follow-up periods of one year or less.

The available evidence also limits the conclusions we can draw regarding the effectiveness of these programs for older adults as well as whether the effectiveness of these programs differs by gender or ethnicity. With only a few exceptions, studies either limited participation to individuals younger than age 65 or, if older adults were included, did not examine differences by age. However, the few existing studies of older adults were RCTs with large numbers of participants.

Few studies of HRA stratified results by gender. None of the studies examined ethnic differences; in fact, most studies either did not report the ethnic composition of the sample or used predominantly Caucasian samples. Thus, without further evidence, it should not be assumed that interventions that are effective with younger or middle-aged adults will necessary show similar benefits among older adults, nor that interventions found to be effective in predominantly Caucasian samples will be similarly effective for members of other ethnic groups.

CONCLUSIONS

The number of controlled studies evaluating the effectiveness of Health Risk Appraisal (HRA) is limited and the quality of this evidence varies widely across studies. Keeping these limitations in mind, conclusions and recommendations based on the evidence were formulated by RAND and its panel of experts.

1. Effective HRA programs have demonstrated beneficial effects on behavior (particularly exercise), physiological variables (particularly diastolic blood pressure and weight), and general health status. More research would be useful to understand the effectiveness of HRA on other health parameters, such as clinical screening and psychological distress.

2. Interventions that combine HRA feedback with the provision of health promotion programs are the interventions most likely to show beneficial effects. Such studies have reported short to medium term effects on a variety of health behavior and physiologic outcomes. It is not known if these effects persist over the long term.

3. HRA questionnaires must be coupled with follow-up interventions (e.g., information, support and referrals) to be effective. The HRA questionnaire alone or with one-time feedback is not an effective health promotion strategy.

4. Evidence from which to draw conclusions regarding the effectiveness of HRA for older adults is limited, yet encouraging. Several randomized controlled trials of programs that included HRA found initial beneficial effects on some health parameters.

5. Current literature is insufficient to accurately estimate the cost effectiveness of programs using HRA. Limited evidence suggests that a carefully designed program that uses a systematic approach to implement HRA and subsequent disease prevention/health promotion interventions has the potential to be cost-beneficial. Considerable effort is needed to optimize program design, implementation, and evaluation.

6. All controlled research studies for which outcome data were collected used paper-and-pencil administration of the HRA, sometimes with telephone follow-up. Therefore, the potential impact of new modes of administration (personal computer, Internet) on the effectiveness and cost-effectiveness of programs that included HRA cannot be evaluated at this time.

7. No studies evaluated the effectiveness of HRA on specific racial and ethnic populations. Several senior HRAs are available in Spanish. Asian-language HRAs in the United States could not be located.

RECOMMENDATIONS

Given these conclusions, the following recommendations are made:

1. As HRAs have the potential to improve the health of seniors in a cost-effective manner, a Medicare demonstration to assess the effectiveness and cost-effectiveness of the HRA approach in comprehensively and systematically improving or maintaining health should be conducted.

2. A demonstration project should use regular, ongoing follow-up rather than one-time feedback or counseling, as this approach appears to be more effective. The level of intensity required in follow-up interventions is a question the demonstration will need to answer.

3. A demonstration project should explore the feasibility of linking beneficiaries to community-based services.

4. A demonstration project should compare different modes of HRA administration and follow-up (e.g., Internet, phone, mail) to learn more about their impact on costs and outcomes.

5. A demonstration project should explore how to translate the HRA approach into a benefit that might be incorporated within the Medicare program.

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APPENDIX

Table 6. Data for Forest Plot of Smoking Cessation Studies

Author Year	Timing (months)	Measure	Arm-Intervention	Sample Size	Proportion Who Quit	Risk ratio* (CI)	Risk difference* (CI)
Logsdon 1989	12	# who quit	HRA w/o feedback	136.3	0.073	---	---
Logsdon 1989	12	# who quit	HRA w/feedback + counseling	157.3	0.140	1.906 (0.936, 3.882)	0.067 (-0.003, 0.136)
Gomel 1991	12	% quit	HRA w/feedback	40	0.05	---	---
Gomel 1991	12	% quit	HRA w/feedback +health promotion program + education	28	0.07	1.429 (0.214, 9.547)	0.021 (-0.095, 0.138)
Gomel 1991	12	% quit	HRA w/feedback + health promotion program	30	0.04	0.667 (0.063, 7.014)	-0.017 (-0.110, 0.077)
Gomel 1991	12	% quit	HRA w/feedback + incentives	30	0.2	4.000 (0.867,18.448)	0.150 (-0.008, 0.308)
Kreuter 1996	6	% quit	HRA w/o feedback	60	0.17	---	---
Kreuter 1996	6	% quit	HRA w/feedback + enhanced feedback group	61	0.13	0.787 (0.333, 1.857)	-0.036 (-0.162, 0.091)
Kreuter 1996	6	% quit	HRA w/feedback + typical feedback group	59	0.12	0.712 (0.290, 1.745)	-0.048 (-0.173, 0.077)
Smith 1995	6	% quit = Initial-FU	HRA w/partial feedback	9	0	---	---
Smith 1995	6	% quit = Initial-FU	HRA w/feedback + counseling + full feedback group	12	0	NA; see footnote	0.000 (0.000, 0.000)
Smith 1995	6	% quit = Initial-FU	HRA w/feedback + counseling + partial feedback group	38	0.105	NA; see footnote	0.105 (0.008, 0.203)
Smith 1995	6	% quit = Initial-FU	HRA w/feedback + full feedback group	29	0.069	NA; see footnote	0.069 (-0.023, 0.161)
Burton 1839	24	% quit	Booklet	240.7	0.179	---	---
Burton 1839	24	% quit	HRA w/feedback + counseling	251.5	0.242	1.357 (0.958, 1.921)	0.064 (-0.008, 0.135)
Erfurt 1991	36	% quit among initial	HRA w/ feedback	228	0.171	---	---
Erfurt 1991	36	% quit among initial	HRA w/feedback + education	223	0.176	1.022 (0.683, 1.531)	0.004 (-0.066, 0.074)
Erfurt 1991	36	% quit among initial	HRA w/feedback + counseling	197	0.203	1.187 (0.798, 1.767)	0.032 (-0.042, 0.106)
Erfurt 1991	36	% quit among initial	HRA w/feedback + health promotion program	143	0.189	1.104 (0.708, 1.721)	0.018 (-0.063, 0.098)

Table 6. Data for Forest Plot of Smoking Cessation

Author Year	Timing (months)	Measure	Arm-Intervention	Sample Size	Proportion Who Quit	Risk ratio* (CI)	Risk difference* (CI)
Shi 1992	24	% quit use FU N	HRA w/ feedback, newsletter	185	0.492	---	---
Shi 1992	24	% quit use FU N	HRA w/feedback + health resource center	133	0.444	0.902 (0.709, 1.147)	-0.048 (-0.159, 0.063)
Shi 1992	24	% quit use FU N	HRA w/feedback + health promotion program + case management	60	0.633	1.288 (1.011, 1.640)	0.141 (-0.000, 0.283)
Shi 1992	24	% quit use FU N	HRA w/feedback + health promotion program	155	0.613	1.246 (1.028, 1.511)	0.121 (0.016, 0.226)
Shipley 1988	24	% quit	HRA w/o feedback	258	0.174	---	---
Shipley 1988	24	% quit	HRA w/ feedback + health promotion program	302	0.202	1.158 (0.818, 1.639)	0.028 (-0.037, 0.092)
Shipley 1988	24	% quit	HRA w/feedback + health promotion program + attended smoking clinic	79	0.316	1.814 (1.193, 2.758)	0.142 (0.030, 0.255)
Family Heart Study Group 1994	12	prevalence at FU	HRA w/o feedback	822.5	0	---	---
Family Heart Study Group 1994	12	prevalence at FU	HRA w/feedback + counseling	686.3	0.045	NA; see footnote	0.045 (0.030, 0.061)

Table 7. Data for Blood Pressure Forest Plot

Standard deviation assumed=16mm Hg; correlation assumed=0					Systolic blood pressure (mm Hg)		Dystolic blood pressure (mm Hg)	
Author Year	**Timing (months)**	**Measure**	**Arm - Intervention**	**Sample Size**	**Mean**	**Difference of means (SE)**	**Mean**	**Difference of means (SE)**
Leigh 1992	12	Change in blood pressure	HRA w/o feedback	867	1		0	
Leigh 1992	12	Change in blood pressure	HRA w/feedback + Health promotion program	919	0	-1 (1.07)	-1	-1 (0.74)
Smith 1985	6	Change in blood pressure	HRA w/partial feedback	20	-14		-2	
Smith 1985	6	Change in blood pressure	HRA w/feedback & counseling + full feedback group	90	-6	8 (5.59)	-12	-10 (3.85)
Smith 1985	6	Change in blood pressure	HRA w/feedback & counseling + partial feedback group	94	-11	3 (5.57)	-8	-6 (3.83)
Smith 1985	6	Change in blood pressure	HRA w/feedback + full feedback group	22	7	21 (6.99)	-12	-10 (4.81)
Johns 1976	4	Change in blood pressure	HRA w/o feedback	33	-3.5		3.6	
Johns 1976	4	Change in blood pressure	HRA w/feedback and physician counseling	29	-4.5	-1 (5.76)	-4.7	-8.3 (3.96)
Johns 1976	4	Change in blood pressure	HRA w/feedback and health educator counseling	28	-8.4	-4.9 (5.81)	-2.1	-5.7 (4.00)
Connell 1995	12	Change in blood pressure	Pure control	158	0			
Connell 1995	12	Change in blood pressure	HRA w/feedback and health promotion program	142	-5	-5 (2.62)		
Connell 1995	12	Change in blood pressure	HRA w/feedback	253	-3	-3 (2.29)		
Connell 1995	12	Change in blood pressure	Health promotion program only	248	-3	-3 (2.30)		
Gemson 1995	6	Change in blood pressure	HRA w/o feedback	48	-0.4			
Gemson 1995	6	Change in blood pressure	HRA w/feedback + counseling	42	-3.6	-3.2 (4.78)		

Table 7. Data for Forest Plot of Blood Pressure Studies

Standard deviation assumed=16mm Hg; correlation assumed=0					Systolic blood pressure (mm Hg)		Dystolic blood pressure (mm Hg)	
Author Year	**Timing (months)**	**Measure**	**Arm - Intervention**	**Sample Size**	**Mean**	**Difference of means (SE)**	**Mean**	**Difference of means (SE)**
Williams 1997	24	Total blood pressure	HRA w/o feedback	393	135.14		73.5	
Williams 1997	24	Total blood pressure	HRA w/feedback + health promotion program	405	132.7	0.3 (1.60)	73.26	-0.94 (1.10)
Williams 1997	48	Total blood pressure	HRA w/o feedback	393	133.83		73.13	
Williams 1997	48	Total blood pressure	HRA w/feedback + health promotion program	405	131.24	0.15 (1.60)	72.53	-0.3 (1.10)
Family Heart Study Group 1994	12	Systolic blood pressure	HRA w/o feedback	3576	135.31		84.52	
Family Heart Study Group 1994	12	Systolic blood pressure	HRA w/feedback + counseling	2984	128.17	-6.85 (0.56)	81.38	-3.30 (0.39)

Table 8. Data for Forest Plot of Cholesterol Studies

Standard deviation assumed equal to 50mm/dl; Correlation assumed=0					
	Timing (months)	**Arm Intervention**	**Sample Size**	**Mean[1]**	**Difference of means (SE)**
Fries 1993	24	HRA w/o feedback	142	217	
Fries 1993	24	HRA w/feedback + Health promotion program	146	217	0 (6.33)
Leigh 1992	12	HRA w/o feedback	867	217	
Leigh 1992	12	HRA w/feedback + Health promotion program	919	216	-1 (3.35)
Smith 1985	6	HRA w/ partial feedback	19	264	
Smith 1985	6	HRA w/feedback + counseling + full feedback group	88	248	-16 (17.89)
Smith 1985	6	HRA w/feedback + counseling + partial feedback group	87	275	11 (17.91)
Smith 1985	6	HRA w/feedback + partial feedback group	10	269	5 (27.63)
Connell 1995	12	Control	158	0*	
Connell 1995	12	HRA w/feedback + Health promotion program	142	-5*	-5 (8.18)
Connell 1995	12	HRA w/feedback	253	-3*	-3 (7.17)
Connell 1995	12	Health promotion program only	248	-3*	-3 (7.20)
Gemson 1995	6	HRA w/o feedback	48	-7.5*	
Gemson 1995	6	HRA w/feedback + counseling	42	-8.2*	-0.7 (14.94)
Bertera 1993	24	Control	7101	202.36	
Bertera 1993	24	HRA w/feedback + Health promotion program	7178	204.04	1.68 (1.18)
Family Heart Study Group 1994	12	HRA w/o feedback	3576	218.96	
Family Heart Study Group 1994	12	HRA w/feedback + counseling	2984	213.87	-5.09 (1.75)

EVIDENCE TABLES

Evidence Tables are provided in a separate file.